

# **WATER STORAGE IN MONTANA**



*Ruby Dam*

A Report Submitted to the  
Sixty-first Montana Legislature

Office of the Governor

Pursuant to  
Montana Code Annotated, Sec. 85-1-704 (1991)



January 2009



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## **I. EXECUTIVE SUMMARY**

Montana law requires the Governor to submit a report on water storage to the Legislature each regular session. The Governor's Report on Water Storage in Montana prioritizes new rehabilitation and construction projects and summarizes rehabilitation and repair projects occurring during the previous two years. Appendix I contains MCA 85-1-703 Water Storage Policy and MCA 85-1-704, Priority Ranking of Water Storage Projects – Governor's Report.

For the 2011 Biennium, the Department of Natural Resources and Conservation (DNRC) will be requesting funding from the Water Storage Special Revenue and Hydropower accounts and Renewable Resource Grant and Loan Program (RRGL) grants for the rehabilitation of Ruby Dam, repairing and planning future construction projects on the Two-Dot Canal, the Deadman's Basin Outlet Extension Project, the Martinsdale East Dam Drain Rehabilitation, and repairing and planning future construction on the Nevada Creek Delivery Canals. DNRC is proposing retaining a dam safety engineer through the EPP process to be located within DNRC to document the condition of dams located on State School Trust lands.

In the last biennium, DNRC received a RRGL Program grant and a loan for the rehabilitation of Ackley Lake Dam. Additional funding for the project was requested as a biennial appropriation from the Water Storage Special Revenue Account. The rehabilitation is under construction with completion anticipated in the fall of 2008. The rehabilitation of the East Fork Siphon, part of the East Fork Water Project, (Granite County) will be completed in December of 2008. The outlet structure at the Nilan North Dam (Lewis and Clark County) was replaced in the spring of 2007 with a new structure.

New automated monitoring instrumentation was installed at Middle Creek Dam (Gallatin County) in the fall of 2008. The Smith Creek Canal (Lewis and Clark County) was repaired and relined to control seepage and increase water delivery efficiency. The final design for the Deadman's Basin Dam (Wheatland County) outlet structure was completed in preparation for a future rehabilitation project. The Deadman's Basin Supply Canal was also relined with funds from an NRCS grant, with the DNRC supplying in-kind design and engineering oversight services.

Elsewhere, the Tongue River Dam (Big Horn County) Prototype Panel Repair Project involved the repair of damaged concrete on the pre-cast panels of the emergency spillway. The Martinsdale North Dam (Wheatland County) Riprap Project which involved stabilizing a slope to eliminate continued plugging of the intake structure was completed in the fall of 2007.

DNRC staff is in the process of completing a rehabilitation feasibility study for Frenchman Dam (Phillips County). The study is tentatively scheduled for completion by December 2008. A rehabilitation feasibility study is also currently under development for Cataract Dam, located in Madison County.

Recently completed or ongoing work on non-state owned water storage projects include: The addition of a new upstream outlet tower and gates along with replacement of upstream concrete at Lake Frances East Dam (Phase II); reconstruction of Carter Ponds Dam; installation of monitoring wells at Beaver Creek Dam to collect data needed for the design and construction of a seepage berm; spillway modifications for Mill Lake Dam in the Bitterroot-Selway Wilderness scheduled for the fall of 2007; and planning for the rehabilitation of Vandalia Dam in Valley County.

Photos of the various projects are linked to the online version of the Governor's Report on Water Storage at: <http://dnrc.mt.gov/wrd>. Refer to attached State Water Projects Reference Guide for revised cost figures.



## **II. INTRODUCTION**

The Office of the Governor is required by statute to submit a report on water storage to the legislature each regular session. The Governor's Report on Water Storage in Montana reviews state water storage policy and statutory criteria used for prioritization of proposed projects; identifies water storage projects proposed for development, including the rehabilitation of existing projects and progress on new projects; and summarizes water storage projects in progress over the previous two years.

The focus of this report is on projects that are partially or fully funded by the state. Projects that are regulated by the state with outside funding sources are also included. The federal government has a number of ongoing projects, primarily considered as maintenance, that are not included in the report. The report includes a table summarizing the prioritized projects and a map (see Figure 1) indicating each project type and its location. Information of water storage policy and statutory criteria can be found in Appendix.

### **Renewable Resource Grant and Loan (RRGL) Program**

The Montana Renewable Resource Grant and Loan (RRGL) Program provides grant and loan funding for projects that conserve, manage, develop, or protect renewable resources. RRGL loans are made available to public entities with proceeds from the sale of coal severance tax secured bonds and frequently are offered at a subsidized interest rate. The subsidy is paid with coal tax revenues. DNRC's recommendation includes the amount of financing needed to meet project and financing expenses and the interest rate suggested. Public loans are limited to an applicant's ability to repay under the standard repayment terms and by the bonding capacity of DNRC. Applicants who receive grant funding in conjunction with a loan do not receive an interest subsidy.

Statutorily, \$4M is available in funding for the RRGL Program. However, DNRC is requesting \$6.5M in funding for the 2009 legislative session (2011 Biennium) which includes a total of \$50,000 for private water project grants. In past sessions, the legislature has elected to apply a \$100,000 limit on individual grants, although it has authority to appropriate additional funding for projects. The 60<sup>th</sup> Legislature appropriated an additional \$2.2 million in grant funding in 2007 for the 2009 biennium, making it possible to fund 77 projects. In addition to the \$7.2 million made available for grants, \$400,000 was appropriated for project planning grants, \$100,000 for emergency grants, and \$100,000 to conduct an irrigation infrastructure inventory in the 2009 biennium. Of the 77 projects funded, 4 DNRC water storage projects received grant funding. (See Table 2.)

DNRC has requested RRGL grant funding for five water storage projects in the 2009 biennium. Additionally, \$2.45M in RRGL loans has been requested by DNRC for three state-owned water storage projects for the 2009 biennium. (See Table 1.) Matching federal funds and substantial private contributions are also used to help fund project rehabilitation costs. Funding approved in previous legislative sessions must be reauthorized by the current legislature.

### **Water Storage Special Revenue and Hydropower Earnings Accounts**

Dams classified as high-hazard that are in unsafe condition receive first preference for use of funds from the state's Water Storage Special Revenue Account (Section 85-1-631 MCA). This account was designated by the 1991 Legislature to allocate 25 percent of the grant funds available, or

\$500,000 each biennium, under the Renewable Resource Grant and Loan (RRGL) program, to be used exclusively for water storage projects.

Revenue deposited in the Water Storage State Special Revenue Account provides funds “exclusively for construction, operation, rehabilitation, expansion, maintenance, and modification of state-owned water storage projects”. Money not expended from the water storage account during the previous biennium must remain in the account. Deposits to the account are placed in short-term investments and accrued interest is deposited in the account. Interest income of the resource indemnity trust fund would continue to provide \$500,000 deposited in the water storage state special revenue account created by MCA 85-1-631.

The Hydropower Program administers the development and operation of hydropower facilities on state-owned water projects. The Broadwater Power Project on the Missouri River near Toston is the only state-owned hydropower facility that has been built. Earned revenues are used to help finance the rehabilitation of water storage projects administered by the DNRC State Water Projects Bureau (SWPB). After debt payments and operating expenses, approximately \$1.3 million in funding is available to rehabilitate state-owned dams per year, assuming average river flows.

### **Water Storage Project Classification and Terminology**

It is important that the reader have a basic understanding of principles and terms related to dam safety classification used in this report. Standards used by the State of Montana classify a dam spillway as *unsafe* if it would be unable to route the maximum inflow design flood or if the dam's structural integrity has become compromised since construction. A dam is classified as *high-hazard* if its failure has the potential for loss of human life, regardless of its age and current structural condition. The high-hazard classification should not be confused with an assessment of a dam's structural integrity or condition.

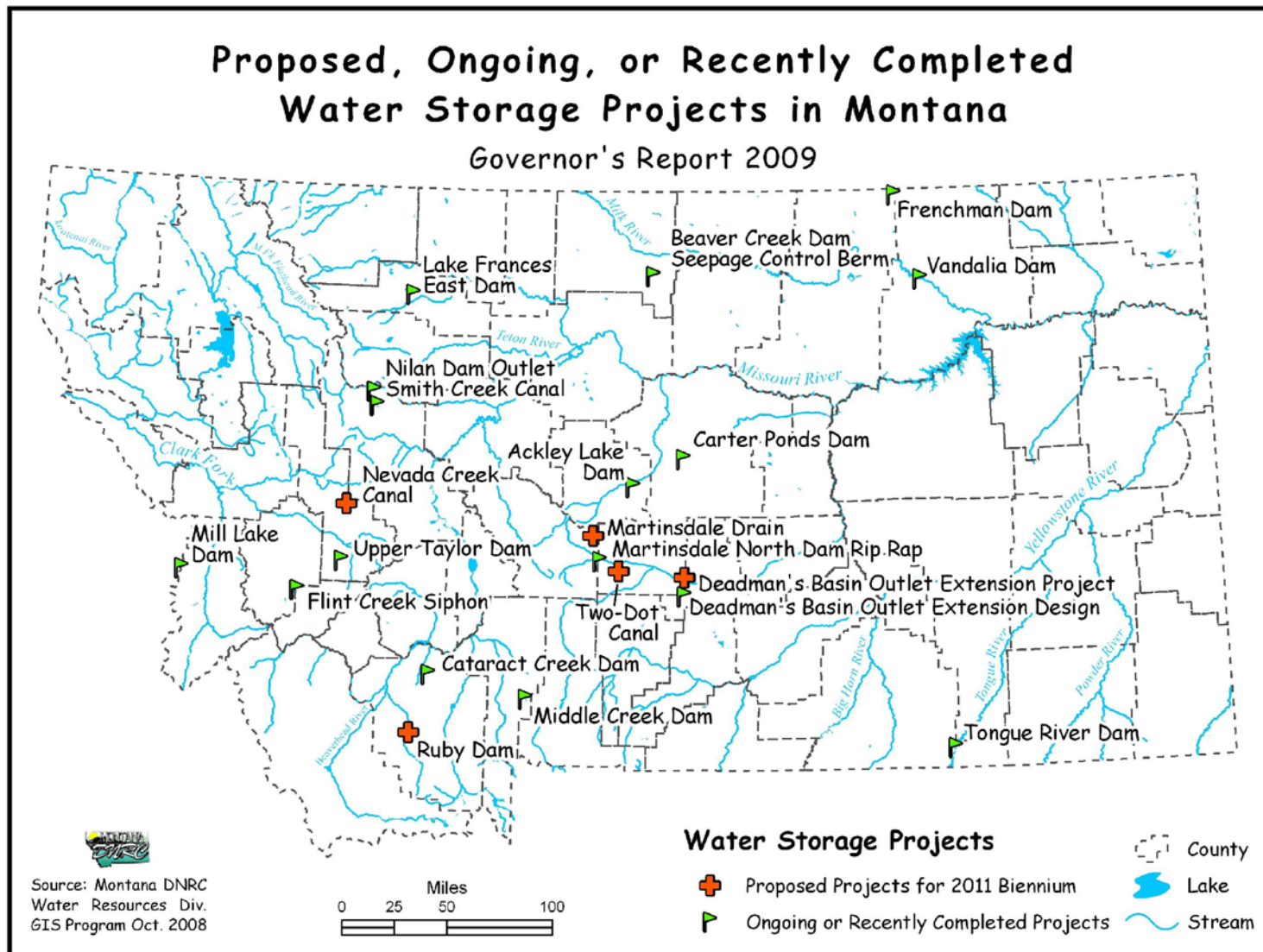
The state's highest priority for repair and rehabilitation is assigned to dams classified as high-hazard that are in unsafe condition. All water storage projects addressed in the Governor's Report are classified high-hazard, and will remain classified as high-hazard following the completion of any ongoing or proposed work. However, the safety issues with each project will eventually be resolved.

*Repair* of a project most often refers to scheduled or emergency action taken to return dam function to original design capacity or for a project to continue operation at a reduced, but safe level.

*Rehabilitation* involves upgrading existing projects to comply with or exceed current design standards and often includes repair work. Design standards have evolved considerably since the construction of most of the state's dams and repair alone may not bring a facility into compliance with current design standards. The storage capacity of a project can be increased somewhat during rehabilitation, especially if it is determined to be a cost-effective alternative.

DNRC's State Water Projects Bureau (SWPB) is responsible for overseeing the operations, maintenance, and rehabilitation of 21 active state-owned water storage projects across the state. DNRC is also responsible for overseeing repairs, maintenance, and rehabilitation of over 250 miles of irrigation canals associated with ten state-owned projects. Canals are integral components of many state water projects, delivering water to water users served by the respective projects. Many of these canals were constructed in the 1930s and 1940s and are now in need of substantial rehabilitation. The Canal Operations Program is responsible for identifying and correcting operational deficiencies on state-owned canals.

Figure 1. Water Storage in Montana Project Location Map 2009



## WATER STORAGE PROJECTS PRIORITIZED

One of the requirements of the water storage report is to prioritize storage projects proposals for the upcoming biennium. After careful evaluation of the nature and extent of deficiencies, potential for loss of life downstream, and economic impact should the project fail; the following suggested prioritization has been developed:

- 1. Ruby Dam Rehabilitation** (Madison)
- 2. Two-Dot Canal Rehabilitation** (Wheatland)
- 3. Deadman's Basin Dam Terminal Outlet Replacement Project** (Wheatland)
- 4. Nevada Creek Canal Design and Construction** (Powell)
- 5. Martinsdale Dam Drain Rehabilitation** (Wheatland)

Table 1 lists storage project proposals for the 2011 Biennium in order of priority, and tabulates funding sources. Table 2 lists ongoing or recently completed storage projects during the past biennium. Dams classified as high-hazard that are in unsafe condition receive first preference for use of funds from the state's Water Storage Special Revenue Account (Section 85-1-631 MCA). Additionally, revenue received from the state's Hydropower Earnings Account is used to assist in the rehabilitation costs of active state-owned water projects.

The Montana Renewable Resource Grant and Loan (RRGL) Program provides funding for resource-related projects that conserve, manage, develop, or initiate the beneficial use of a renewable resource. As shown in Tables 1 and 2, matching federal funds and substantial private contributions are also used to assist with rehabilitation costs.

**Table 1. 2011 Biennium Water Storage Project Proposals Prioritized**

<b>Storage Project Name</b> (County) <i>Applicant / Owner</i>	<b>RRGL Grant</b> <b>Rank/Amount</b> <b>Requested</b>	<b>Water Storage</b> <b>Special</b> <b>Revenue</b> <b>Account</b>	<b>RRGL</b> <b>Loan</b>	<b>Other</b> <b>(Funding</b> <b>source)</b>
<b>1) Ruby Dam Rehabilitation</b> (Madison County) <i>Dept. of Natural Resources &amp; Conservation (DNRC)</i>	\$100,000 (rank 9)	Pending Review	\$2,000,000	Pending Review
<b>2) Two-Dot Canal Rehabilitation</b> (Wheatland County) <i>DNRC</i>	\$100,000 (rank 25)			DNRC In-Kind \$18,511
<b>3) Deadman's Basin Dam Terminal Outlet Replacement Project</b> (Wheatland) <i>DNRC</i>	\$100,000 (rank 40)	\$514,500	\$400,000	DNRC In-Kind \$63,352
<b>4) Nevada Creek Canal Design and Construction</b> (Powell) <i>DNRC</i>	\$100,000 (rank 64)	\$20,035	\$50,000	Nilan Water Users Association \$12,450
<b>5) Martinsdale Dam Drain Rehabilitation</b> (Wheatland County) <i>DNRC</i>	\$100,000 (rank 42)			DNRC In-Kind \$29,525

### III. JUSTIFICATION FOR 2011 BIENNIUM PROJECT PROPOSAL PRIORITIZATION

The following rehabilitation projects are prioritized by Montana Department of Natural Resources and Conservation (DNRC) according to the criteria identified by Sec. 85-1-704 (4) (MCA) listed in Appendix I of this report. The Renewable Resource Grant and Loan Program (RRGL), administered by DNRC, independently ranks project proposals using a set of criteria that includes priority consideration for water storage projects. A number of the projects addressed in this report are seeking partial funding from the RRGL Program.

#### **1) Ruby Dam Rehabilitation Project** (*Madison County*)

The Ruby Dam and Reservoir is located on the Ruby River, in Madison County approximately 7 miles south of Alder. The dam is owned by the DNRC and managed by the SWPB. The project has been operated by the Ruby River Water Users Association since the dam was built in 1938. Storage at full pool (top of the existing flashboards) is 37,642 acre-feet. 149 water users have 219 contracts for 38,845 acre/feet of water.

The spillway condition has been deteriorating for many years. An inspection conducted by the U. S. Army Corps of Engineers (COE) in 1981 found the spillway capacity inadequate and showing serious deterioration. For this reason, the COE classified the dam as unsafe according to the standards set forth under the National Dam Inspection Act, Public Law 92-367. The spillway has since deteriorated to the point that replacement of the entire structure is needed.

The proposed action calls for the construction of a new spillway with dimensions similar to the existing structure. The existing spillway would be removed. The new spillway will be designed to meet or exceed all current state dam safety requirements. The existing low level outlet control gate will be removed and the downstream portion of the outlet works conduit will be slip lined with a new control gate installed on the downstream dam toe. A new outlet terminal structure will also be constructed to replace the existing deteriorating structure.

Sedimentation has reduced the storage capacity of the reservoir by approximately 2,000 acre-feet over the past 70 years. In order to enhance and re-establish the original storage capacity of the reservoir, the proposed action calls for the spillway crest to be raised 7.0 feet above the existing flashboards, and the dam crest raised 4 feet. The action will increase the existing capacity of the reservoir from 37,642 (existing top of flashboards) to 45,115 acre-feet, providing an additional 7,473 acre-feet of storage (recovers the original water right plus 5,265 acre-feet). of which 2,600 acre feet is proposed to become an established minimum pool for the reservoir, and to support downstream fisheries and their beneficial uses.

The overriding goal of this project is to improve the efficiency, safety, and functionality of the dam for its continued use for agricultural irrigation and recreation. Public benefits from this project include providing reservoir water for agricultural irrigation, recreation, fisheries, and wildlife habitat. Greatly enhanced public safety is an additional and very significant benefit.

The estimated cost in 2007 dollars for this project is \$12 million. The Department is requesting an RRGL Program grant of \$100,000 (rank 9) and a loan of \$2,000,000. Other funding sources of the \$12M total may include a combination of general funds and Water Storage Account and Hydropower Earnings Account funding, including approximately \$132,000 of in-kind DNRC services. The proposal meets criteria 3 (a) (b) and (c) of the water storage statute.

## **2) Two-Dot Canal Rehabilitation Project (*Wheatland County*)**

The Upper Musselshell Water Project located in Wheatland County is owned by DNRC and operated by the Upper Musselshell Water Users Association. This project includes three dams, two reservoirs, capturing a maximum of 30,134 acre-feet in storage, and five canals measuring 52 miles in length. The original project was completed in 1939. The 32-mile Two-Dot Canal carries water from the Musselshell River to Antelope Creek. The canal has deteriorated due to age and requires substantial rehabilitation. The canal is a critical component of the Upper Musselshell Project.

The proposed rehabilitation will stabilize potentially hazardous sloughing that is occurring on a hillside adjacent to U.S. Highway 12. Failure of the canal in this location would flood the highway and endanger the public. A \$100,000 RRGL Program grant (rank 25) is being requested. The DNRC will provide in-kind services totaling \$18,511, for a total project cost of \$118,511. The proposal meets criteria 3 (a) (b) and (c) of the water storage statute.

## **3) Deadman's Basin Terminal Outlet Replacement Project (*Wheatland County*)**

Deadman's Basin Dam is located in Wheatland County, approximately 9 miles west of Ryegate, Montana (Figures 1 & 2). The dam, owned by DNRC and operated by the Deadman's Basin Water Users Association, was completed in 1941 and raised 10 feet in 1958. Annual inspections have reported seepage overtopping the outlet structure, erosion of material behind the outlet, excessive seepage and standing water on the downstream side of the dam, and deterioration of the outlet structure.

A relief ditch installed in the 1980s to alleviate the standing water has head-cut over the years and is now a possible route of soil piping. The exit gradient of the seepage at the downstream toe of the dam has a factor of safety below that required by State Dam Safety standards. The high exit gradient increases the potential for the movement of embankment materials and subsequent deterioration of the dam.

Project tasks include:

1. Remove the outlet structure, extend the conduit, and install a drainage system.
2. Build a new energy dissipating type of outlet terminal structure.
3. Build a 15-foot high toe berm with a filter blanket drain

The conduit extension will incorporate a seepage filtration collar to reduce the likelihood of sediment transport and piping.

DNRC is requesting an RRGL Program grant of \$100,000 (rank 40) and a loan for \$400,000 to contribute to the project. Additional funding includes \$514,500 from the Water Storage Account, and \$63,352 from DNRC in-kind contributions. The estimated total cost of the project is \$1,077,852. The design construction documents will be completed in 2008. The proposal meets criteria 3 (a) (b) and (c) of the water storage statute.

## **4) Nevada Creek Canal Design and Construction Project (*Powell County*)**

Nevada Creek Dam is an earthen embankment dam located near Helmville in Powell County. The dam was completed in 1938 and is owned and operated by DNRC. Nevada Creek Dam is 105 feet high and 1,083 feet long. At normal full pool, the reservoir storage is 11,152 acre-feet.

The dam has two associated delivery canals, the North Canal and the Douglas Canal, both of which are in poor condition. The Douglas Canal is 12.6 miles long and the North Canal is 13.4 miles long. Stream channel migration and undercutting at the toe of the North Canal has raised concerns over stability issues. Other major issues that must be addressed are excessive seepage, over-steepened canal sections resulting in erosion and sedimentation, and site access.

The Douglas Canal has several locations showing severe seepage. The particular section proposed for lining under this grant is adjacent to Nevada Creek. The canal bank has shown some indication of sloughing in the past. If the canal bank were to fail in the subject reach, the canal water would dump into Nevada Creek, causing excessive environmental damage. The overall condition of the canals is promoting loss of water, increasing operations and maintenance costs, and is becoming a public and environmental hazard at certain locations.

DNRC's \$100,000 RRGL Program grant request (rank 64) will provide engineering services to model the delivery system, make recommendations on structural modifications throughout the system, provide a means to prioritize repair projects on both canals, and provide for some construction repairs. The proposal meets criteria 3 (a) (b) and (c) of the water storage statute.

#### **5) Martinsdale Dam Drain Rehabilitation Project** *(Wheatland County)*

Martinsdale Reservoir is located approximately 2.5 miles southeast of Martinsdale and was constructed in 1939. A large amount of seepage has historically occurred in the abutments of the North Dam since construction. Grouting programs conducted in 1941, 1962-63, and 1965 to control the seepage had limited success. Additional horizontal abutment drains were installed in 1985 to collect the seepage and improve the stability of the embankment. The configuration of the horizontal drain system makes it unsafe and difficult to monitor the drain flows. Accurate flow measurements are also difficult to obtain from the original toe drain system.

Additionally, sedimentation is occurring in the toe drain with no means to be accurately measured. Excessive seepage and sedimentation from the drains may indicate a potential problem within the dam, but this cannot be ascertained with the existing drain configuration. The need to measure drain flows and sedimentation rates is crucial to determining if rehabilitation is needed to keep the dam safe. In order to improve seepage collection and be able to make accurate measurements of drain flow rates and sedimentation transport volumes, rehabilitation of the drain structures is necessary.

The proposed work includes reconstruction of the drain systems to allow accurate and safe measurements of flow and sedimentation rates. The work includes adding manholes to the toe drain system for flow measurements and trapping sediment, and redirecting the outfall of the horizontal drain system further downstream which will allow for safe and accurate flow measurements of that drain system. Automated reservoir level instrumentation will be installed to allow continual monitoring of the reservoir. To address the remaining seepage, a right groin drainage system will be installed. The improved monitoring capabilities are required in order to comply with the current operating permit conditions. The total project budget is estimated to cost approximately \$129,525. A \$100,000 grant request has been submitted to the RRGL program and is ranked 42. The proposal meets criteria 3 (a) (b) and (c) of the water storage statute.



#### IV. ONGOING OR RECENTLY COMPLETED REPAIR OR REHABILITATION PROJECTS

**Table 2. Recently Completed or Ongoing Water Storage Projects (2007 or 2009 Biennium)**

<b>Storage Project Name</b> (County) <i>Applicant / Owner</i>	<b>RRGL Grant Awarded 2007, 2009 Biennium</b>	<b>Water Storage Special Revenue Account</b>	<b>RRGL Loan</b>	<b>Other (Funding source)</b>
<b>State Owned Projects</b>				
<b>Ackley Lake Dam Rehabilitation</b> (Judith Basin County) <i>DNRC</i>	\$100,000	\$300,000	\$200,000	Hydropower Earnings \$800,000
<b>Flint Creek Siphon Rehabilitation</b> (Granite County) <i>DNRC</i>	\$100,000	\$300,000	\$400,000	Hydropower Earnings \$320,000; NRCS Grant \$902,684
<b>Middle Creek Automated Instrumentation</b> (Gallatin County) <i>DNRC</i>	\$100,000			
<b>Smith Creek Canal Lining and Rehabilitation Project</b> (Lewis and Clark County)	\$100,000		\$50,000	
<b>Nilan North Dam Outlet Repairs</b> (Lewis & Clark)		\$105,000		
<b>Deadman's Basin Outlet Structure Design</b> (Wheatland County) <i>DNRC</i>		\$25,000		Hydropower Earnings \$50,000
<b>Cataract Feasibility &amp; Evaluation</b> (Madison) <i>DNRC</i>				Hydropower Earnings \$75,000
<b>Tongue River Dam Prototype Panel Repair Project</b> (Big Horn) <i>DNRC</i>				\$152,000 – Remaining Tongue River Project Rehabilitation funds
<b>Martinsdale North Dam Rip Rap Installation</b> (Wheatland) <i>DNRC</i>	\$100,000 (2005)		\$92,000	Water users \$25,000 Hydro Earnings \$45,000
<b>Frenchman Dam Rehabilitation Feasibility Engineering</b> (Phillips) <i>DNRC</i>	\$100,000 (2005)			\$65,000 DNRC In-kind
<b>Upper Taylor Dam Rehabilitation</b> (Powell County) <i>Montana Dept. of Corrections</i> (MDOC)	\$80,000 (2003)			MDOC \$ 23,449
<b>Monitoring Instrumentation for State-owned Dams</b> <i>DNRC</i>				General Fund \$5,000 per year

<b>Non-State Owned Projects</b>				
<b>Lake Frances East Dam Rehabilitation</b> (Pondera) <i>Pondera County Canal Co.</i>				\$5000 – private grant and loan program; remainder privately funded
<b>Carter Ponds Dam Reconstruction</b> (Fergus) <i>Private w/ FWP Access</i>	\$100,000 (2007)			
<b>Beaver Creek Dam</b> (Hill) <i>Hill County</i>	\$100,000 (2007)			Hill County Reserves \$169,749
<b>Mill Lake Dam Rehabilitation</b> (Ravalli County) <i>Mill Creek Irrigation District</i>	\$100,000 (2003)		\$472,000 (2003)	Mill Creek I.D. \$290,487 (spec.) Mill Creek I.D. \$98,315 (in kind) Mill Creek I.D. \$25,498 (O&M)
<b>Vandalia Dam</b> (Valley) <i>Glasgow Irrigation District</i>	\$100,000 (2005)			

## **Ongoing or Recently Completed Projects**

### **State-Owned Rehabilitation and Repair Projects**

The following section contains current information concerning state owned projects that were in progress when reported in the 2007 Governors Report on Water Storage, or were started during the past two years. Some projects have been completed during the last two years, while work on others is expected to continue into the next biennium.

#### **Ackley Lake Dam Rehabilitation** (*Judith Basin County*)

Ackley Lake Reservoir is owned by DNRC, with daily operations and maintenance the responsibility of the Ackley Lake Water Users Association. The dam and canal system was constructed by the State Water Conservation Board in 1938. Water from the reservoir is used for irrigation and recreation. The dam and reservoir are located in Judith Basin County approximately 10 miles south of Hobson.

The construction phase of the rehabilitation project, which includes installation of a toe berm and drain system, began in September 2008. The rehabilitation of Ackley Lake Dam will bring this high hazard project into full compliance with Montana Dam Safety regulations. The project is schedule for completion by December of 2008.

### **The Flint Creek Siphon Rehabilitation** (*Granite County*)

The Flint Creek Siphon is a 54-inch diameter, 4,056 foot-long steel pipe installed in 1938 and owned by DNRC. Water stored in East Fork of Rock Creek Reservoir is diverted from East Fork of Rock Creek, below the dam, over a divide to the Flint Creek drainage where it is used for irrigation of lands located between Phillipsburg and Drummond. The rehabilitation project, which will replace the old pipe with a new one, began in August 2008. Completion is scheduled for December 2008.

### **Middle Creek Dam Automated Instrumentation** (*Gallatin County*)

Middle Creek Dam is located approximately 15 miles south of Bozeman in the headwaters of Hyalite Creek in the Gallatin Range. The purpose of this project was to enhance the current dam safety program at Middle Creek Dam, by (1) Installing an automated instrumentation system at the dam to improve the ability of DNRC to monitor and evaluate both reservoir operations and embankment performance, and (2) Evaluating the feasibility and cost of installing an early warning instrumentation system that would alert emergency response personnel in the event of a dam failure. The installation of the automated instrumentation began in September 2008, with completion scheduled by June of 2009.

### **Smith Creek Canal Seepage Abatement and Rehabilitation – Nilan Dam** (*Lewis & Clark*)

The Nilan Dam Water Project is owned by the DNRC and operated by the Nilan Water Users Association. The Project was originally comprised of a 10,092 acre-feet, off-stream reservoir, a 5.5 mile-long supply canal, and three delivery canals, totaling 23.5 miles in length. Storage water carried by the supply canal is provided by two sources, Smith Creek and Ford Creek. The Smith Creek branch of the supply canal is 3.7 miles long. The construction of the original project was completed in 1951, and ownership of the 16.5-mile Florence Canal was transferred to the water users in 1995. The rehabilitation project is scheduled to begin in September 2008. Approximately 5,000 feet of the canal will be reshaped and graded, with 1,600 feet lined. The project is scheduled for completion by December 2008.

### **Nilan North Dam Terminal Outlet Structure Repair** (*Lewis & Clark County*)

The Nilan North Dam is located 6 miles west of Augusta in Lewis & Clark County. The dam is owned by DNRC with daily operations and maintenance undertaken by the Nilan Water Users Association. The reservoir can store approximately 10,000-acre feet of water at full pool. The reservoir is a popular recreation area, with fishing the primary attraction.

The repair work included replacing the outlet structure and installing filters and drains at the outlet terminal structure to control and collect seepage. The outlet structure at the North Dam was in very poor condition structurally and had deteriorated to the point that additional small repairs and patching were not economical or feasible. There was also a considerable amount of seepage that exited in the location of the outlet. The new drain installation encircles the end of the conduit to safely discharge seepage water.

The rehabilitation provides a safe outlet structure and will control seepage at the dam. The repairs and improvements will enhance the longevity of the dam, promote effective water conservation, and greatly enhance public safety. The project was completed in the spring of 2007 for a cost of approximately \$126,083.

### **Deadman's Basin Outlet Structure Design** (*Wheatland County*)

Deadman's Basin Dam and Reservoir are located in Wheatland County approximately 18 miles east of Harlowton. The dam is owned by DNRC and operated and maintained by the Deadman's Basin Water Users Association. The earth-fill dam is 60 feet high, has a crest length of 1,490 feet, and impounds 76,900 acre-feet of water at full pool. The stored water is used for irrigation and some minor municipal uses. Recreation is also a major benefit of the reservoir, although no specific allocation to this use currently exists. The dam was completed in 1941.

Western Water was awarded the contract for the design. A final design was submitted in September 2008. A RRGL Grant and Loan request has been submitted to help fund the construction phase of the project, which is tentatively scheduled for 2009, pending 2009 legislative funding approval.

### **Cataract Creek Dam Feasibility and Alternative Evaluation** (*Madison County*)

Cataract Creek Dam is located in Madison County, about two miles southwest (upstream) from the Community of Pony and eight miles southwest of the Town of Harrison. The reservoir is fed by Cataract Creek, which originates 2.3 miles southwest of Cataract Creek Dam at Mason Lake. The Cataract Water Users Association operates the dam. The earth-fill dam was completed in 1959. HKM Engineering of Billings was awarded the contract for the feasibility study which is scheduled for completion by winter 2009.

### **Tongue River Dam Prototype Panel Repair Project** (*Big Horn County*)

Tongue River Dam is located in Big Horn County on the Tongue River and is owned by DNRC and operated by the Tongue River Water Users Association. The Prototype Panel Repair Project involves the repair of damaged concrete on the pre-cast panels of the emergency spillway. Various prototype repairs were installed. The performance of these repairs is being evaluated over several seasons with varying weather conditions. The most effective, durable, and economical repair will be selected and implemented over the remainder of the spillway. This project was funded with \$152,000 in private funds obtained from a settlement from the Tongue River Dam Rehabilitation.

### **Martinsdale North Dam Rip Rap Installation** (*Wheatland County*)

Martinsdale Reservoir is an off-stream storage project owned by DNRC and capable of storing 23,348 acre-feet of water. The reservoir is located about 2.5 miles southeast of the Town of Martinsdale. Water from the reservoir is used primarily for irrigation water supply, but is also used for water-based recreation. The reservoir, completed in 1939, includes two earthen embankment dams (East Dam and North Dam). The dams are classified as high hazard.

The outlet works is located through the North Dam near the right abutment. It consists of an intake structure, a 60-inch diameter reinforced concrete pipe tunnel, a dry tower with an operating gate and an emergency gate, and an outlet structure. The inlet to the outlet conduit has had a recurring problem with plugging from sediments. The inlet structure plugged in 1989, 2000, 2001, and 2002. The most serious incident occurred in September 2000. The plug was eventually removed by water jet cleaning of the outlet conduit from the downstream side of the outlet conduit, and pumping water into the inlet tower. About 200 cubic yards of sand, silt and gravel was removed from the outlet conduit and intake structure. Since 2000, significant funds have been spent unplugging the conduit and excavating sediment from around the intake structure.

DNRC assembled a funding package including a 2005 \$100,000 RRGL grant, a \$92,000 RRGL loan, \$45,000 from the Hydropower Earnings Account, and \$25,000 from the water users association. The project involved draining the reservoir, reshaping the area surrounding the inlet structure, and armoring the slope with rock. The project was completed in the spring of 2008.

### **Frenchman Dam Rehabilitation Feasibility Pre-construction Engineering** *(Phillips County)*

Frenchman Dam is located about 22 miles north of Saco, in Phillips County. The project is situated on Frenchman Creek, a tributary of the Milk River. The drainage area of the project encompasses 2,460 square miles. The DNRC-owned dam is operated and maintained by the Frenchman Water Users Association. The dam is 44 feet in height and 2,100 feet long, with a dike on the west end that is 8 feet tall and 1,000 feet long. The original earth-fill dam was completed in 1951.

The dam failed on April 15, 1952 due to very high stream flows resulting from rapid snowmelt and a very rapid filling of the reservoir. The dam was reconstructed in 1952-1953 with a larger spillway and revisions to the seepage cutoff. Annual dam safety inspections have revealed voids that developed over time beneath the spillway. DNRC received an RRGL Grant in the amount of \$100,000 from the 2005 Legislative session and \$65,000 was provided by in-kind services from DNRC.

DNRC staff has initiated a rehabilitation feasibility study for the rehabilitation of Frenchman Dam. An engineering consulting firm was selected and conducted a hydrologic and water availability analysis. A drilling company was contracted to perform the borehole drilling and sampling. State Water Projects staff conducted the on-site geotechnical and geologic oversight during the drilling operations. Work was completed by late fall 2006. State Water Projects staff will finalize the feasibility study by December 2008.

### **Upper Taylor Dam Rehabilitation** *(Powell County)*

The Montana Department of Corrections owns and operates Upper Taylor Dam. The dam is located on property of the Montana State Prison west of the City of Deer Lodge and is 40 feet in height and holds 300 acre-feet of water. The dam is used for irrigation by the State Prison Ranch.

Taylor Dam's principal and emergency spillways were grossly undersized and the corrugated metal outlet pipe has reached the end of its design life. Significant corrosion of the outlet pipe could lead to failure of the entire dam.

The Department of Corrections received a grant from the RRGL Program from the 2001 Legislature for engineering services to develop a rehabilitation design for Upper Taylor Dam. In 2003, the Department of Corrections received an RRGL grant of \$80,000 to fund one-third of the needed cost for repair. The remaining two-thirds of the necessary funding came from proprietary State Prison Ranch funds and machinery with labor provided by the Job Corps as part of a training program.

The work included the addition of an enlarged, rock-lined emergency spillway and slip lining of the current outlet pipe. The slip lining of the outlet pipe was completed in November 2006 and the rehabilitation was completed in fall of 2008.

## **Monitoring Instrumentation for State-Owned Projects** *(Statewide & ongoing)*

Seepage monitoring is required as a condition of the operating permits for all dams regulated by the Montana Dam Safety Program. Twenty-two DNRC dams are regulated under the MT Dam Safety Program and have monitoring wells installed. The SWPB is currently upgrading the seepage monitoring data collection systems on DNRC's projects as funding allows.

To date, instrumentation systems have been installed on Tongue and East Fork Dams including new data loggers and other associated equipment. Instrumentation improvements are on-going at Middle Creek Dam. At locations where these systems are not in place, measurements are taken by hand. The data is collected monthly, reviewed and compared to historical trends. The ongoing process meets criteria 3 (a), (b), and (c) of the water storage statute.

## **Canal Operations**

The DNRC State Water Projects Bureau Canal Operations Program is responsible for identifying and correcting operational deficiencies of 250 miles of state-owned canals. Major ongoing or recently completed activities include the following:

- Deadman's Basin Supply Canal – Additional lining was installed on the canal to remediate flood damage sustained in the spring flood of 2005. An extremely pervious reach of the canal, 2000-feet in length, will be lined by October, 2008.
- Smith Creek Supply Canal – A design, which will repair flood damage incurred by the canal in 2005, was completed. Approximately one half mile of the canal will be rehabilitated and lined with an EPDM membrane. Completion is anticipated in November, 2008.
- Martinsdale Outlet Canal – A concrete wing wall was replaced on a large chute-type drop structure, Drop Structure #2. The canal prism was lined for a distance of two hundred feet upstream from the drop structure in order to protect the soil supporting the drop structure from eroding. This work was completed in 2007.
- Flint Creek Main Canal – A construction contract was awarded to replace the 70-year-old East Fork Siphon. The existing 4000-ft, 54-inch diameter, steel conduit was replaced by a 48-inch diameter PVC pipe. Completion is scheduled for November, 2008.

## **Trust Lands Dam Inspection Program**

Over the past two years, DNRC's Trust Lands Management Division (TLMD) has worked with the Water Resources Division to bring dams located on School Trust land into compliance with the Montana Dam Safety Act. The majority of dams located on School Trust lands were built by state land lessees in the 1950s and 60s and are aging and in need of repair. (See Figure 2) Several have potential to cause downstream loss of life should they fail. In some cases, as leases have been abandoned, DNRC has become the default responsible party for the dam as land owner. In order to document the magnitude of the problem, the Montana Dam Safety Program requested \$15,000 from the Federal Emergency Management Agency (FEMA) to: 1) Determine how many dams are located on trust lands; and 2) Assess the condition of a representative number of dams. An engineering student was hired to develop a GIS database of trust lands dams. A professional engineer was also hired to conduct inspections and report on the condition of the 176 dams inventoried and identified to be on State School Trust lands. Between July 2006 and May 2007 18 dams, chosen based upon location near population or the existence of known problems, were inspected. Although problems encountered in the 18 dams cannot be assumed to be proportionally representative of all Trust Land dams, conclusions can be drawn reasonably by examining this small percentage of dams.

**Key findings include:**

1. Outlet works are at the end of their useful life: Seventeen of the 18 dams have a corrugated metal pipe (CMP) outlet. CMP outlets reach the end of their design life in 30 years. Six of 7 recorded dam failures in Montana in the past 5 years were caused by failure of deteriorated CMP.
2. Potential for loss of life: Thirteen of the 18 dams have roads or occupied dwellings downstream. For dams with capacity greater than or equal to 50 acre-feet, a high hazard classification application must be submitted to the DNRC Dam Safety Program. For dams with capacity less than 50 acre-feet, an informal hazard assessment is necessary. An emergency action plan should be immediately developed for each dam with potential for loss of life downstream, regardless of capacity.
3. Lack of maintenance: All of the dams need maintenance. Lack of maintenance, such as tree and rodent removal and upstream slope protection is the cause of many failures or near failures nationwide (a rodent hole caused a dam in Garfield County to fail in 2002).
4. Compliance with Montana Dam Safety Act: Major repairs were done on 2 of the 18 dams without proper permitting or notification of Trust Lands. State law requires that dam owners submit a hazard classification application to the DNRC Dam Safety Program before proceeding with major dam repairs to any dam with a 50 acre-feet or greater capacity. For dams with a capacity less than 50 acre-feet, repairs should be coordinated with the Trust Lands Management Division.
5. Legal liability: DNRC Trust Land Management Division (TLMD) may be liable for any damages caused by a dam failure regardless of permitting status or capacity of dam.
6. Need for major repairs: Eleven of the 18 dams require major repairs, which could be very costly. Breaching a dam susceptible to failure may be a preferred alternative to repair.
7. Dam inventory updating: Three of the 18 Trust Land dams inspected were not on the dam inventory. The number of dams on Trust Lands could be greatly underestimated.

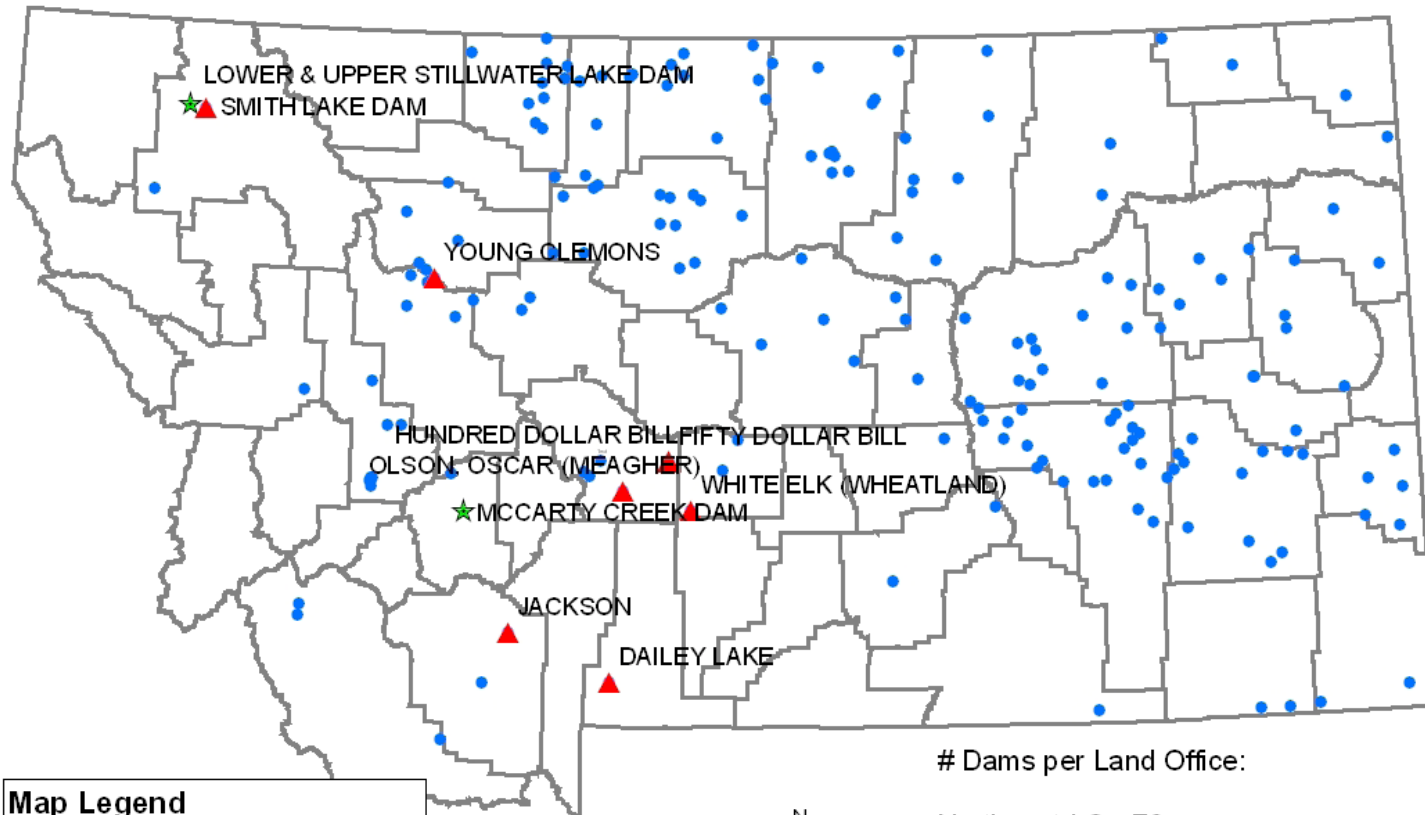
**Conclusion/Recommendations**

The majority of dams located on State School Trust lands are in need of maintenance, repair, rehabilitation, or breaching. The potential for loss of life from failure of the dams is unknown, but could be significant. DNRC could be held responsible for damages should dam failure occur. Trust Lands Management Division should initiate a program within the next two years to bring dams located on School Trust lands up to current dam safety standards. The Trust Land Dam Program should include the following components:

- 1) Outreach: Communicate current dam operation procedures, maintenance standards and requirements of state law to lease holders;
- 2) Identification & Assessment: Inventory all dams located on state lands and identify downstream hazards;
- 3) Compliance: Bring dams into compliance with the Montana Dam Safety Act;
- 4) Inspection: Conduct periodic inspections of dams (both state and lease holders); and
- 5) Repair or Removal: Hazardous dams must be repaired or breached. A funding mechanism must be in place to repair or remove potentially hazardous dams abandoned by lease holder.
- 6) To accomplish the forgoing tasks, DNRC is proposing retaining (1) FTE dam safety engineer through the EPP process to be located within DNRC.



## Dams on School Trust Lands



### Map Legend

- ▲ Pilot Study Dams
- ★ Pilot study Dams - not on inventory
- Dams on trust land

# Dams per Land Office:

Northeast LO - 79  
 Eastern LO - 50  
 Central LO - 35  
 Southern LO - 3  
 Northwest LO - 2

Figure 2. Dams on School Trust Lands

## **Non-state owned Rehabilitation and Repair Projects**

### **Lake Frances East Dam Rehabilitation** *(Pondera County)*

Lake Frances is located in Pondera County, near the Town of Valier. The North and East dams, measuring twenty and sixty feet in height, create the reservoir. The Pondera County Canal and Reservoir Company owns both dams, which were constructed in 1908-1909. Storage capacity is 105,000 acre-feet, which is considered large for a privately owned reservoir. The stored water is used for irrigation, municipal use by the City of Conrad, and for recreation by the general public. Both dams are classified as high hazard since the failure of either structure presents the potential to cause loss of life and property damage.

The outlet works on the East Dam have been slowly deteriorating over time. In 2002, an extensive grouting program was conducted to seal voids in the earthen embankment. It is believed that slow piping of material into the outlet conduit caused the voids. In 2003, the outlet conduit and gate tower were sampled to evaluate the condition of the concrete. Originally, it was thought that complete outlet replacement would be needed. However, after additional investigation, it was determined that the outlet could be rehabilitated.

A two-phase rehabilitation approach was used. Phase I, completed in 2007, involved the addition of a downstream drainage system and berm. Phase II, completed in 2008, focused on the upstream section of the dam with the construction of a new outlet tower and replacement of the upstream conduit and intake structure. HKM Engineering completed the design and oversaw construction.

### **Carter Ponds Dam Reconstruction** *(Fergus County)*

Upper and Lower Carter Pond Dams are located about six miles north of Lewistown. The Carter Ponds are widely used by the local community for fishing and recreation. The ponds also provide waterfowl habitat, storm water retention, and stock water. Each pond has a Montana Department of Fish, Wildlife, & Parks (FWP) fishing access site. The dams and most of the shoreline are privately owned, but a walk-in public easement surrounds both reservoirs. The upper pond site has been developed with a restroom, gravel boat launch, and picnic tables. The lower site is not developed. Fishing use is substantial with about 1,600 angler-days each year.

Early in 2004, the trickle tube on the lower dam collapsed, but the dam did not fail. In July 2004, the upper dam had a gradual failure due to pipe corrosion. DNRC recommended reconstruction or breaching of both dams. A rural fire hydrant that serves 200 to 300 people located at Upper Carter Pond was not functioning due to low water. The community was distraught at the prospect that the dams would require breaching.

The Fergus County conservation district in cooperation with Ducks Unlimited, a private landowner; local, state, and federal entities received an RRGL grant in 2007 (rank 22) of \$100,000 to match other funds being raised for the repair of both dams. The reconstruction was completed in summer of 2008 and each dam will now store approximately 140 acre-feet of water. The project was an example of how parties of interest could join together and save a project with multiple community and wildlife values.

### **Beaver Creek Dam – Seepage Control Berm** *(Hill County)*

Beaver Creek Dam is located on Beaver Creek approximately 13 miles south of Havre. The dam is owned and operated by Hill County and provides flood control, recreation, irrigation, and fish and wildlife benefits for the residents of Havre and surrounding community. The project was planned, designed and funded by the Natural Resources Conservation Service (NRCS) under the authority of the Watershed Protection and Flood Prevention Act (PL-566). Hill County also provided funds for the project. Construction was completed in 1974. The dam is considered to be a high hazard structure and is regulated by DNRC.

Periodic inspections raised several concerns with seepage on the right abutment and with operation of the outlet works. In 2001 RRGL funds were awarded Hill County to hire an engineer to study repair options. Hill County contracted with HKM Engineering to evaluate problems at the dam. HKM developed alternatives for repair of the outlet works and preliminary design for repair of the right abutment seepage.

Seepage in this area has been a persistent concern since dam was constructed. Recent data collection efforts have shown that seepage pressure in the foundation is higher than originally anticipated. Engineers that have studied the data are in agreement that the seepage poses a serious threat to the stability of the dam. DNRC subsequently put a condition on the operation permit for the dam that the seepage problem must be addressed before 2009.

Hill County received an RRGL grant of \$100,000 (rank 17) in 2007 for final design and construction of a stability berm and drainage system on the right abutment of the dam. Hill County provided cost share funds in the amount of \$169,749. Several monitoring wells were drilled in summer 2008 and data will be collected for one year for adequate information to design and construct the berm.

### **Mill Lake Dam Rehabilitation** *(Ravalli County)*

Mill Lake Dam is located in the Selway-Bitterroot Wilderness Area and is located approximately fifteen miles west of the Town of Hamilton. The dam is owned by the Mill Creek Irrigation District, regulated by the U.S. Forest Service, and stores water used for irrigation. The dam, built in 1908, is an unsafe, high hazard dam in need of rehabilitation to meet standards of the Montana Dam Safety Program. The dam spillway is unable to convey the Probable Maximum Flood, which is a requirement of the U.S. Forest Service. Repairs to this dam are challenging due to Forest Service restrictions regarding activities permitted within wilderness areas.

Mill Lake Dam was experiencing excessive seepage around the outlet pipe and embankment. In 2005, the outlet works was slip lined, the upstream face of the dam was lined and rip-rapped, and the deteriorated outlet pipe was slip-lined to alleviate seepage and a possible resulting dam breach. During the fall of 2007, a new inlet structure and outfall, including a measuring device, were installed. Additionally, early warning instrumentation was installed, and a portion of the dam crest was replaced with rock-filled gabion baskets. The third phase of the project includes the removal and replacement of riprap on the upstream face of the dam, lining of the upstream face of the dam, and spillway improvements. Phase three bids are currently being evaluated, and construction is scheduled for the summer and fall of 2009. Financing for the final phase of the project will include the balance of a \$100,000 Renewable Resource Grant and a \$572,000 Renewable Resource Loan that was authorized by the 2003 Legislature.

### **Vandalia Dam Rehabilitation** (*Valley County*)

Vandalia Diversion Dam is located on the Milk River, about three miles west of Vandalia, in Valley County. The dam diverts water into Vandalia Main Canal for irrigation of land in the vicinity of the towns of Vandalia, Tampico, Glasgow, and Nashua. The dam has been in continuous use since it was constructed in 1917. The Glasgow Irrigation District (GID) and the US Bureau of Reclamation have performed regular maintenance and safety inspections over the years. An engineering analysis of the structure resulted in recommendations for repairs in several phases.

The primary goal of the project is to preserve the integrity and increase the service life of Vandalia Diversion Dam. A secondary goal is to conserve the water resources available to GID. Reduction of losses due to seepage and spilling will increase usable supply for district members and other upstream users. The 2005 legislature authorized a \$100,000 grant for the Glasgow Irrigation District to complete Phase III of repairs to Vandalia Dam. The project was contracted in the spring of 2008. Originally the project was to replace struts and walkways on the dam. An engineering study indicated that more immediate needs were to repair two dam gates and install a new seal on the gates and repair corroded concrete on the surface of the dam. Struts and walkways will be replaced if excess funds are available. The project is expected to be completed by December 2009.

## V. HYDROPOWER

The State Hydropower Program administers the development and operation of hydropower facilities on state-owned water projects. To date, one hydropower facility, the Broadwater Power Project near Toston, has been built. With a maximum capacity of 10 megawatts, the Broadwater Project began generating power in June 1989. DNRC owns and operates the facility and contracts with NorthWestern Energy to sell the energy.

Earned revenues are used to help finance the rehabilitation of other State Water Projects Bureau (SWPB) water projects. In an average year (assuming mean precipitation runoff), the facility is capable of generating roughly 56 million kilowatt-hours of electricity and earns roughly \$3.5 million in revenue from energy and capacity sales. After debt payments and operating expenses, approximately \$1.3 million is available to rehabilitate state-owned dams.

Most of the water storage projects managed by the SWPB were completed in the late 1930s and early 1940s and have significant needs, either via spillway capacity, long-term seepage issues, or simply structural deterioration over time. The earned revenue from Broadwater is critical for maintaining and repairing these structures so they meet current safety standards and codes. Statistics concerning the Broadwater Power Project during are shown in below.

<b>Broadwater-Missouri Power Project in FY 2007</b>	
Operating availability	99%
Gross energy generation kilowatt-hours	48,908,739
Gross revenue from sales	\$3,503,190
Investment income	\$174,264
Operating costs	(\$455,902)
Bond payments	\$1,849,750
NET REVENUE	\$1,371,802

### Recent Accomplishments

The implementation of major projects designed to resolve problems and enhance operations and maintenance was completed with the Spillway Bridge Replacement Project of 2006. Ongoing minor projects by the operation and maintenance staff include warehouse improvements, camera surveillance system, tool inventory and organization, and writing standard operating procedures for future reference. Some original equipment will require major repair and /or replacement including the main or turbine shaft seal. Staff and its consultants recently completed the Federal Energy Regulatory Commission (FERC) 5-Year Dam Safety Inspection and Report and Potential Failure Mode Analysis, and prepared the Strategic Technical Information Document. Preliminary feasibility studies for retrofitting other state water projects with hydropower are also being undertaken as market prices for electricity continue to rise.

## **State Water Storage Projects Hydropower Retrofit Program**

Legislative authorization was given to DNRC's State Water Projects Bureau (SWPB) in 1981 to study the feasibility of constructing and operating small-scale hydropower on each of the state-owned water projects (Title 85, Chapter 1, Part 5). The legislation was the State's response to a national movement to develop new sources of energy within our own borders. According to the MCA statutes, if a potential hydropower project is feasible, the Department may develop the project's hydropower potential through leases with private parties as a first option, or through its own direct effort if leases are deemed unworkable.

In response to the legislative authorization, the SWPB completed numerous feasibility studies on its water projects in the 1980's, culminating in the construction of the Broadwater Power Project, which has a peak capacity of 10 Megawatts. Other state water projects that were studied in the 1980's had a combined total peak capacity of 15MW. In 1995, the SWPB updated the feasibility study for Tongue River Dam to coincide with the planned dam rehabilitation project. At that time, the project was deemed not feasible due to low market prices for electricity. The SWPB is currently assessing the feasibility of hydropower for the Ruby Dam Project to take advantage of possible cost savings from combining the dam rehabilitation project with construction of a hydropower facility.

While market energy prices were relatively low through the 1990's, generally speaking, prices have risen substantially since utility deregulation in Montana. As market prices continue to rise, the SWPB will continue to reassess hydropower potential on state water projects. Funding and staffing may limit the size of the effort.

## **VI. APPENDIX**

### **A. Water Storage Policy and Statutory Criteria**

The 1991 Montana Legislature passed into law a policy to define when water storage is the best solution for solving specific water problems. When storage is determined to be the best alternative, the policy identifies criteria to use in ranking state-funded projects. (Sections 85-1-701-704 MCA).

#### **85-1-703. Water storage policy**

*(1) The legislature recognizes that water resources needs are growing, existing water facilities are aging and in need of repair, and new water storage projects have become more difficult to complete. Other types of actions will be needed to solve many emerging problems, but if storage is the best way to meet growing water needs and solve problems, it should be actively pursued.*

*(2) In determining the best solution for a particular water management problem, the state shall:*

- a. carefully define the problem;*
- b. identify all options to solve the problem, including water storage;*
- c. determine whether water is physically and legally available to solve the problem; and*
- d. select the option that best meets the following criteria:*
  - i. technical feasibility*
  - ii. financial feasibility*
  - iii . economic feasibility*
  - iv. political feasibility*
  - v. legal feasibility, and*
  - vi. environmental feasibility*

#### **85-1-704 Water Storage Project Prioritization Policy**

The statute calls for this report to the legislature and describes its requirements. The statute also identifies different criteria to be used to prioritize new water storage projects, storage rehabilitation projects, and budget priorities for the allocation of state water storage development funds. Section 85-1-704 Prioritization of water storage projects - governor's report, states:

*(1) The governor shall submit to each regular session of the legislature a report identifying specific water storage projects proposed for development, including the rehabilitation of existing projects and new project proposals. The report must contain:*

- a) a list of water storage project priorities;*
- b) an implementation strategy for each priority project that identifies the resources (including specific budget requests), government actions, and other actions needed to accomplish the project;*
- c) a progress report on the development of water storage projects during the previous 2 years.*

*(2) In setting priorities among new water storage projects, the governor shall consider whether a project:*

- a) solves a severe water problem;*
- b) provides multiple uses and benefits;*
- c) provides for public uses;*
- d) shows strong evidence of broad citizen support;*



- e) is able to obtain non-state sources of funding;*
  - f) protects and seeks to enhance social, ecological, cultural, aesthetic values;*
  - g) improves local and state economic development;*
  - h) could resolve Indian and federal reserved water rights issues;*
  - i) supports water conservation activities; and*
  - j) promotes the use of water reserved under Montana law.*
- (3) In setting priorities among water storage rehabilitation projects, the governor shall consider whether the project:*
- a) is needed to protect public safety;*
  - b) has impacts if not repaired or rehabilitated; and*
  - c) accomplishes the goals listed in subsection (2)(a) through (2)(j).*
- (4) In establishing budget priorities for the allocation of state storage development funds:*
- a) First preference must be given to projects that resolve threats to life and property posed by high-hazard facilities that are in an unsafe condition;*
  - b) Second preference must be given to projects that improve or expand existing water storage facilities; and*
  - c) Third preference must be given to the planning and construction of new water storage facilities.*

**B. State Water Storage Project Fact Sheets** – For revised rehabilitation cost figures, please refer to the attached State Water Projects Reference Guide.

Persons with disabilities who need an alternative accessible format of this document should contact:

Montana Department of Natural Resources and Conservation  
Water Resources Division  
1424 9<sup>th</sup> Ave.  
P.O. Box 201601  
Helena, MT 59620-1601  
Phone: 406-444-6601/Fax: 406-444-0533

*Tongue Dam*

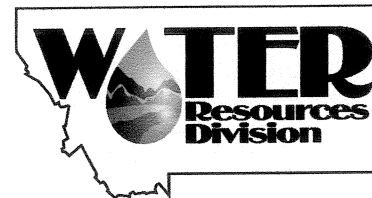


<http://dnrc.mt.gov/wrd>

Montana Department of Natural Resources and Conservation  
Water Resources Division  
1424 9<sup>th</sup> Ave  
P.O. Box 201601  
Helena, MT 59620-1601

Phone: 406-444-6646  
Fax: 406-444-0533





Montana Department of Natural Resources and Conservation  
State Water Projects Bureau

Project Information Report

December 2008



Fred Burr Reservoir

## MT DNRC State Water Projects Bureau

The State Water Projects Bureau (SWPB) administers the operation, management, and rehabilitation of state-owned dams, canals, and hydropower projects under the purview of the DNRC Water Resources Division.

The following report provides a complete list of the projects, along with additional information. The SWPB markets water from the state-owned facilities primarily for irrigation and administers approximately 1,965 water-marketing contracts through local water user associations. The total combined volume of water marketed by the SWPB per year is 293,609 acre-feet. Revenue from the water purchase contracts, leasing of lands associated with the projects, and net revenue from hydropower generation supplement funds for state water project rehabilitation costs. Debt repayment funds are derived from repayment contracts with water users.

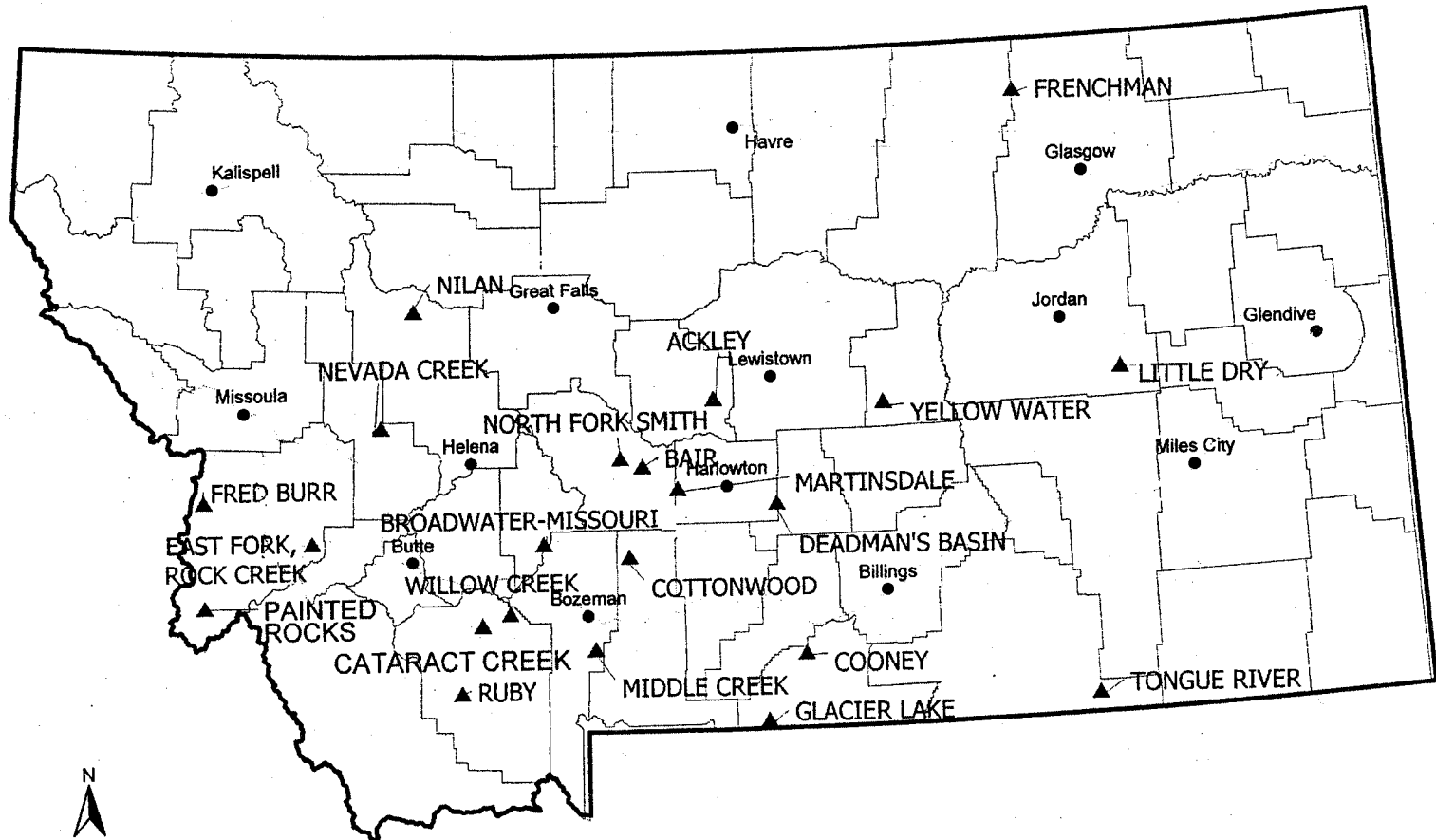
The SWPB ensures that the projects are operated and maintained in a safe, efficient manner, are kept to current dam safety standards, and repayment contracts are properly administered. For additional information or questions, contact the DNRC State Water Projects Bureau.

State Water Projects Bureau  
MT Dept. of Natural Resources and Conservation  
1424 9<sup>th</sup> Avenue, P.O. Box 201601  
Helena, MT 59620-1601  
(406) 444-6646  
[www.dnrc.mt.gov](http://www.dnrc.mt.gov)

### Contents:

Project Location Map  
Ackley Lake Dam  
Bair Dam  
Cataract Creek Dam  
Cooney Dam  
Cottonwood Dam  
Deadman's Basin Dam  
East Fork of Rock Creek Dam  
Fred Burr Dam  
Frenchman Dam  
Glacier Lake Dam  
Martinsdale Dam  
Middle Creek Dam (Hyalite)  
Nevada Creek Dam  
Nilan Dams  
North Fork Smith River Dam  
Painted Rocks Dam  
Ruby Dam  
Tongue River Dam  
Toston Dam (Broadwater-Missouri)  
Willow Creek Dam  
Yellow Water Dam

# DNRC PROJECTS



25 0 25 50 75 Miles







East Fork Reservoir

Persons with disabilities who need an alternative accessible format of this document should contact:

Montana Department of Natural Resources and Conservation  
Water Resources Division  
1424 9<sup>th</sup> Ave.  
P.O. Box 201601  
Helena, MT 59620-1601  
Telephone: (406) 444-6646 / Fax (406) 444-5918

<http://dnrc.mt.gov/wrd>

# **ACKLEY LAKE DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- Off-Stream Storage Project located in Judith Basin County
- 5 miles southwest of Hobson
- Owned by DNRC & managed by SWPB
- Operated by the Ackley Lake Water Users Association since 1938
- Popular recreation site. Ackley Lake State Park, managed under lease by the Dept. of Fish, Wildlife and Parks, surrounds the northern half of the reservoir.
- Project consists of:
  - Earthen Embankment Dam, 51 feet high, 3,514 feet long
  - Unregulated, trapezoidal earthen section spillway
  - 4-foot diameter corrugated 8-gage metal pipe outlet conduit
  - 48-inch diameter slide gate valve, manually operated
- Constructed in 1938 by the State Water Conservation Board
- Storage at full pool is 5,975 acre-feet, 260 surface acres
- Off stream of the Judith River. Main watershed intercepted by the supply canal is Antelope Creek, with a drainage area of 2.6 square miles.
- 27 water users have 53 contracts for 4,766 acre/feet of water

### **PROJECT DEFICIENCIES**

- Excessive uplift pressure may threaten structural integrity.
- Corrugated metal outlet and drain pipes have exceeded design life and need replacement.
- A pool level restriction has been in place due to risk of failure.

### **PROPOSED ACTIONS TO ADDRESS DEFICIENCIES**

Rehabilitation of the dam will significantly reduce the potential for loss of life and would provide for the continued use of the reservoir for agricultural irrigation, recreation and fisheries. The structure does not meet Montana Dam Safety Act standards. Rehabilitation would bring the structure up to code and extend its useful life for another 50 to 75 years.

**Rehabilitation Cost: \$1,487,257.**

Funding was approved by the 2007 Legislature. Rehabilitation will include the installation of new drains, outlet conduit lining, an earthen berm to reinforce the dam embankment, and a new primary and emergency spillway. Upon completion, the project will meet all current safety standards.

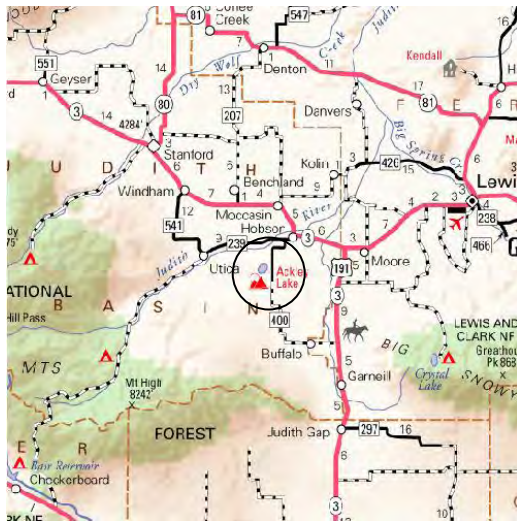
The rehabilitation project is scheduled for completion in the spring of 2009.



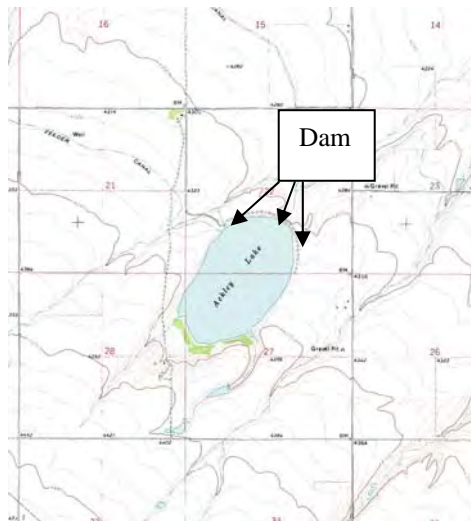
## Project Maps and Photographs



Ackley Lake Dam looking east



Area Map



# BAIR DAM

## Fact Sheet

### PROJECT DESCRIPTION

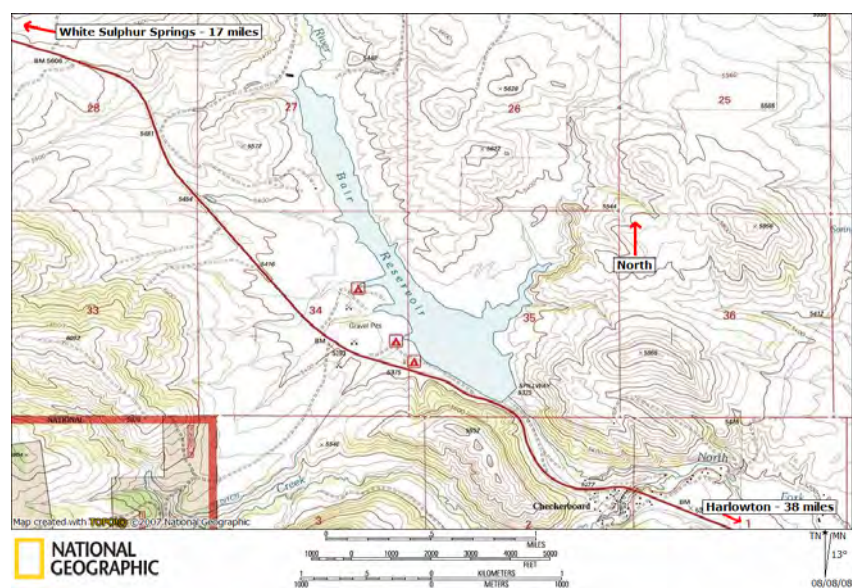
- ◆ Located on the North Fork of the Musselshell River in Meagher County
- ◆ Approximately  $\frac{3}{4}$  mile upstream of Checkerboard
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Upper Musselshell WUA since 1940
- ◆ Project consists of:
  - ◆ Dam, 102' high
  - ◆ Concrete chute spillway
  - ◆ Gated, reinforced concrete outlet conduit
  - ◆ 48-inch butterfly operating gate and 48-inch emergency slide gate with manual operators in a gate house on the dam crest.
- ◆ Original construction completed in 1939
- ◆ Normal storage at full pool is 7,300 acre-feet
- ◆ 11 water users have 21 contracts
  - ◆ Project irrigates approximately 4,100 acres with three canals:  
Northfork Diversion Canal (11.7 miles long), Checkerboard Canal (2.9 miles long)  
Two Dot Canal (32.2 miles long)
- ◆ The dam is a “high hazard” structure which means that its failure could cause loss of life, 94 people would potentially be impacted
- ◆ Checkerboard, numerous houses, roads, bridges, and utilities are located in the flood plain

### REHABILITATION

The Bair Dam was rehabilitated in 2003. The dam now meets all current safety standards, with an expected design life of 50 to 75 years. The rehabilitation consisted of the following:

- ◆ A new structural concrete spillway was constructed in same location as the old one
- ◆ The steep slope above spillway was excavated to gentler slope to alleviate creep and rock fall
- ◆ A new concrete conduit outlet structure was installed.
- ◆ Add additional toe berm to buttress downstream embankment was constructed.
- ◆ New control house, fence, security gates and access road was constructed

### REHABILITATION COST: \$2,738,562





## **PROJECT PHOTOGRAPHS**



**New Spillway**



**New Outlet Structure**



**Bair Dam and Reservoir**

# **CATARACT CREEK DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Impoundment on Cataract Creek, from Mason Lake; tributary of N. Willow Cr.
- ◆ Located approximately 8 miles southwest of Harrison in Madison Co.
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Cataract Creek Water Users Association since 1959
  
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 80 feet high, 775 feet long
  - ◆ Controlled, unlined open channel spillway with concrete drop structure
  - ◆ 30-inch, horseshoe-shaped 390 foot-long reinforced concrete outlet, with two 30-inch diameter gate valves in series.
  
- ◆ Original construction completed in 1959
- ◆ Reservoir stores 1,478 acre-feet at spillway crest
- ◆ Provides irrigation water for 16 farms and ranches
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain. The towns of Pony and Harrison are immediately downstream.

### **PROJECT DEFICIENCIES**

- ◆ Existing spillway earthen channel is not capable of safely passing the design flood event.
- ◆ Excessive seepage in the right abutment may threaten structural integrity.

### **PROPOSED REHABILITATION**

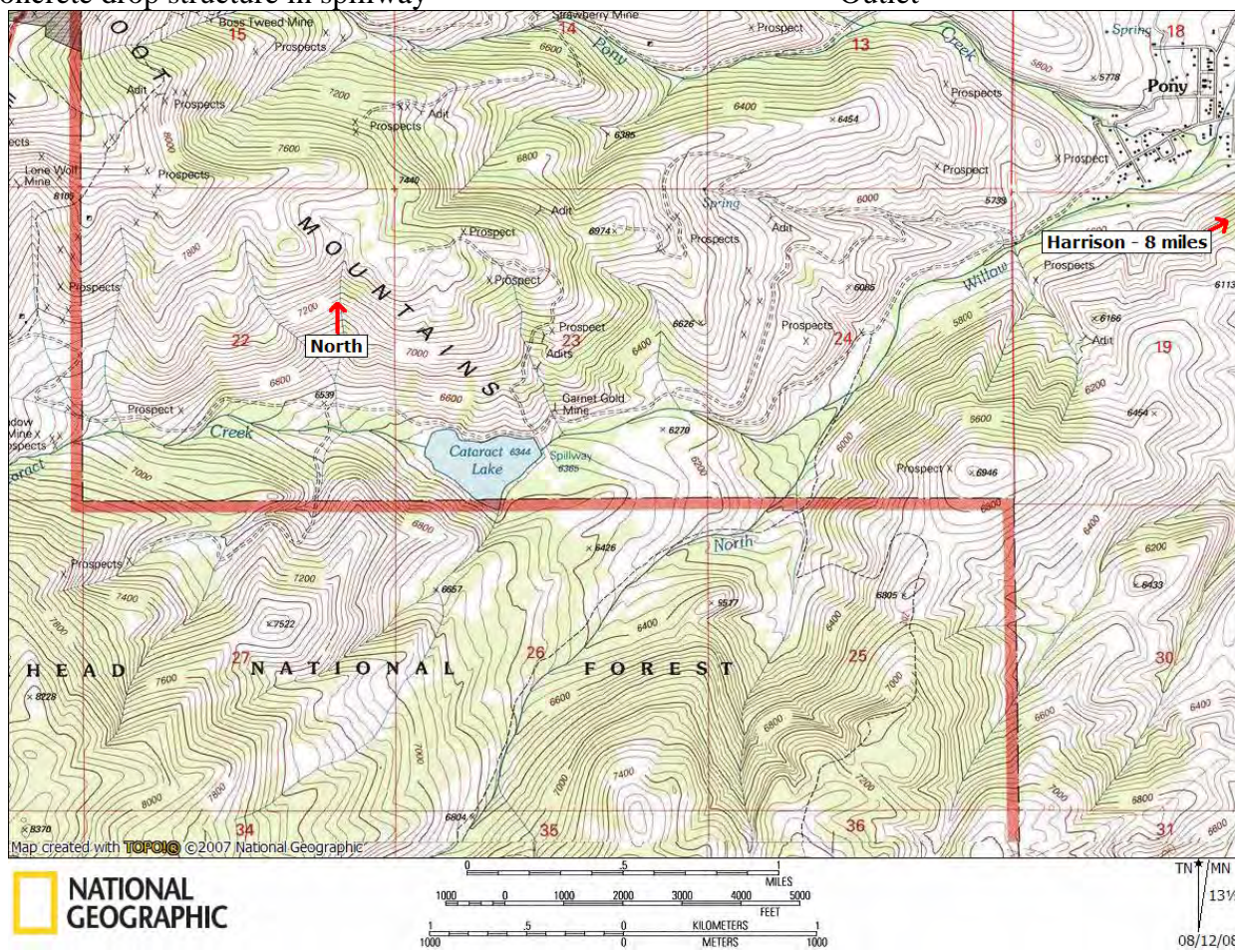
A two-phased rehabilitation process is planned. The first phase requires engineering analysis and alternative evaluation to determine the best course of action to address deficiencies. Funding for phase 1 was approved by the 2007 Legislature. The second phase includes the final design and construction.

The proposed rehabilitation would include:

- ◆ Construction of new spillway and channel that meets current standards.
- ◆ Installation of a new seepage collection and drain system.

Estimated Cost \$5,000,000







# COONEY DAM

## Fact Sheet

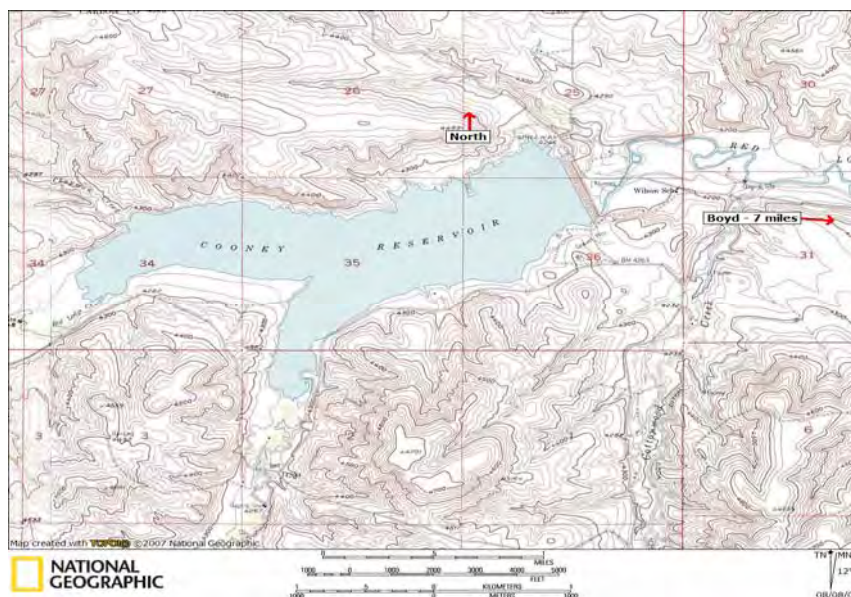
### PROJECT DESCRIPTION

- ◆ Impoundment on Red Lodge Creek; also obtains water from Willow Creek and Glacier Lake Reservoir.
- ◆ Located approximately 8 miles west of Boyd in Carbon County.
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by the Rock Creek Water Users Association since 1937
- ◆ Project consists of:
  - ◆ Earthfill Dam, 102 feet high, 2,369 feet long
  - ◆ Controlled, ogee crest principle spillway with concrete drop structure in left abutment; fuse plug emergency spillway.
  - ◆ 6-foot horseshoe-shaped 630 foot-long concrete outlet, with two 60-inch diameter gate valves (butterfly operating gate and emergency slide gate), in series.
- ◆ Original construction completed in 1937
- ◆ Stores 28,230 acre-feet at guard dike crest; surface area at normal full pool – 1,078 acres
- ◆ Provides irrigation water on approximately 20,000 acres; popular recreation site, with Cooney State Park, managed under lease by the MT Dept. of Fish, Wildlife and Parks, encompassing the north, east and south shore of the reservoir.
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain. The towns of Boyd and Joliet are immediately downstream.

### PROJECT DEFICIENCIES AND REHABILITATION

In 1982 the dam was raised 5-feet and rehabilitated. The dam, spillways and outlet works are in good condition and meet or exceed existing dam safety standards. The rehabilitation included:

- ◆ Raising the dam embankment 5-feet.
- ◆ Replacing the principle spillway
- ◆ Adding a guard dike in the spillway approach channel
- ◆ Adding a fuse plug emergency spillway
- ◆ Replacing the wooden bridge over the principle spillway with a concrete bridge
- ◆ Installing additional drains
- ◆ rehabilitation cost (1982): \$1,288,065



## PROJECT PHOTOGRAPHS



**Upstream Face**



**Spillway**



**Downstream Face**

# **COTTONWOOD DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Impounds Cottonwood Creek in Park County.
- ◆ Located approximately 5 miles north of Wilsall.
- ◆ Owned by DNRC & managed by SWPB.
- ◆ Operated by the Shields Canal Company since 1953.
  
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 39 feet high, 610 feet long.
  - ◆ Earthfill Dike, 8 feet high, 825 feet long.
  - ◆ Uncontrolled guard dike spillway with ogee crested chute and baffle blocks.
  - ◆ 36-inch, 197 foot-long corrugated steel pipe outlet with 36-inch vertical slide gate in a rectangular wet tower with controls at the dam crest.
  
- ◆ Original construction completed in 1953.
- ◆ Reservoir capacity is 1,905 acre-feet at spillway crest, covering 235 surface acres.
- ◆ 1379 acre-feet is under contract with the Shields Canal Company.
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Numerous farms and ranches, roads, bridges, and utilities are located in the flood plain.

### **PROJECT DEFICIENCIES**

- ◆ Existing drains and outlet conduit are deteriorating and at the end of design life.
- ◆ Spillway is undersized and does not meet current safety standards.

### **PROPOSED REHABILITATION**

- ◆ Replace the spillway or increase freeboard to meet current spillway standards.
- ◆ Construct an auxiliary spillway
- ◆ Replacing the outlet conduit with a new structure.
- ◆ Install new drains for seepage control.

Estimated cost: \$1,000,000 for outlet  
\$1,500,000 for spillway





Dike



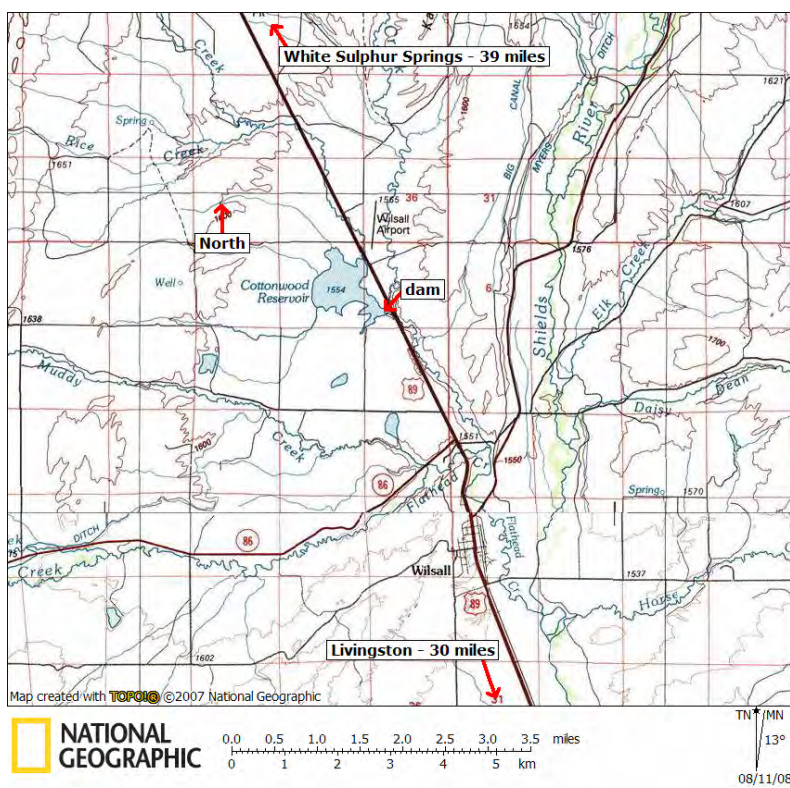
## Downstream face



## Spillway



## Upstream face



# **DEADMAN'S BASIN DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Off-stream reservoir with supply canal from the Musselshell River.
- ◆ Located approximately 10 miles east of Harlowton in Wheatland Co.
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Deadman's Basin Water Users Association since 1959
  
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 80 feet high, 775 feet long and Earthen Embankment Dike, 18-feet high and 2,950 feet long.
  - ◆ Horseshoe-shaped 300 foot-long reinforced concrete outlet tunnel, with two 60x60-inch cast iron slide gates with vertical access tower.
  - ◆ 11.5 mile supply canal (600 cfs), two delivery canals (total 12.5 miles)
  
- ◆ Original construction completed in 1941. The dam was raised 10 feet in 1958.
- ◆ Reservoir stores 76,900 acre-feet at normal full pool, covering 2,120 surface acres.
- ◆ Provides irrigation water for 16 farms and ranches.
- ◆ The dam is a "high hazard" structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain.
- ◆ Melstone, Ryegate, and Roundup are dependent on the water from the reservoir for their municipal water systems.
- ◆ 490 families, including ranchers, farmers, and residents of small towns, directly depend on receiving their contracted water shares from the Deadman's Basin Water Project.

### **PROJECT DEFICIENCIES**

- ◆ Excessive seepage and uplift pressures requires the installation of a drain system and toe berm.
- ◆ Requires extension of outlet structure to accommodate toe berm.

### **PROPOSED REHABILITATION**

- ◆ Remove the old outlet structure, extend the conduit, and install a drainage system along side the new conduit extension
- ◆ Build a new energy dissipating outlet
- ◆ Construct a 15 foot high toe berm with a filter blanket drain

**Estimated Project Cost:** \$1,077,852





Inlet plugged with sediments



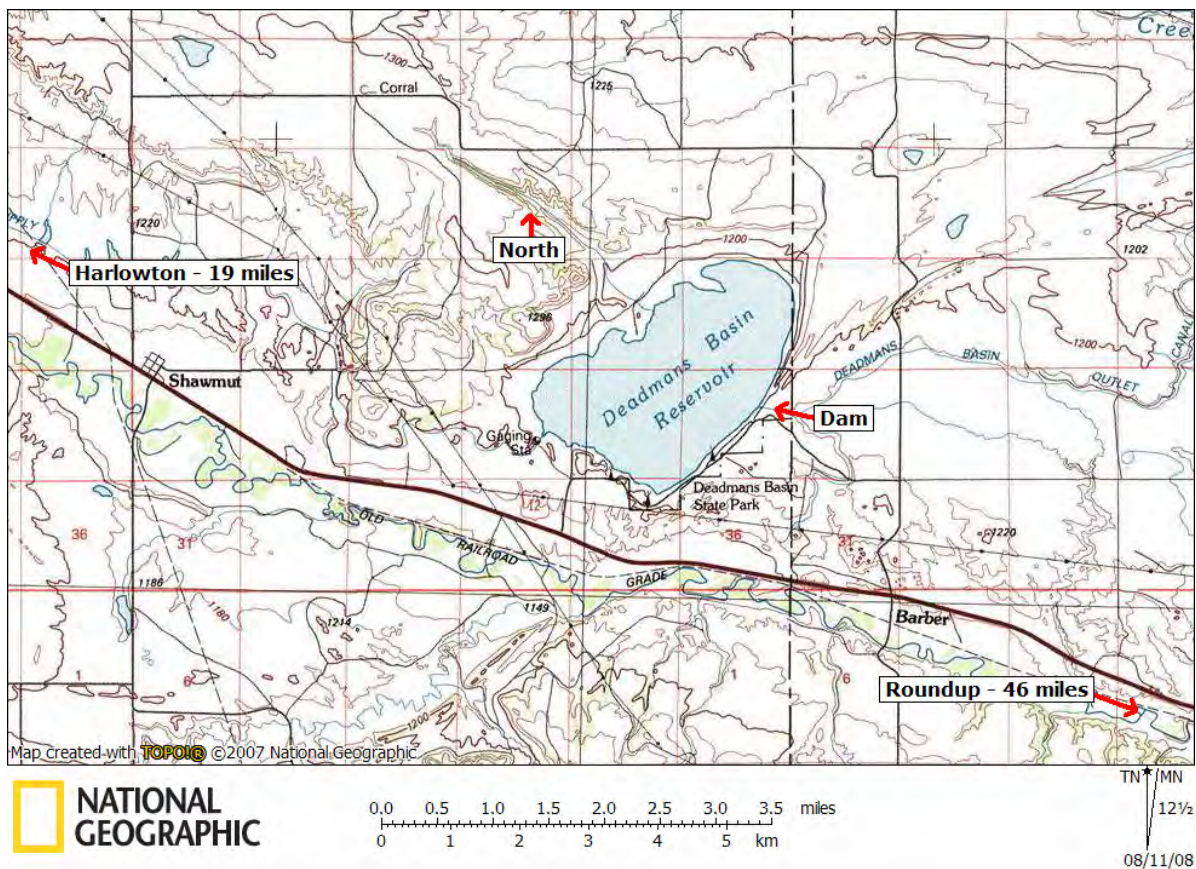
Inlet and upstream face



Low Level Outlet



Low Level Outlet Seepage



# **EAST FORK OF ROCK CREEK DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on the East Fork of Rock Creek 15 miles south of Phillipsburg on the Beaverhead-Deerlodge National Forest in Granite Co.
- ◆ Owned by DNRC & managed by SWPB under a U.S. Forest Service Special Use Permit.
- ◆ Operated by Flint Creek Water Users Association since 1938
  
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 88 feet high, 1083 feet long.
  - ◆ Concrete lined chute spillway with flip bucket energy dissipater
  - ◆ 54-inch horseshoe-shaped 472 foot-long reinforced concrete outlet tunnel, with one 54-inch diameter emergency slide gate and one 54-inch butterfly operating gate
  - ◆ The gate valves are operated from a 7-foot diameter tower on the dam crest.
  
- ◆ Original construction completed in 1936
- ◆ Reservoir stores 16,040 acre-feet at normal full pool covering 390 acres
- ◆ Provides irrigation water for 53 farms and ranches
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain.

### **PROJECT DEFICIENCIES**

- ◆ The spillway is in poor condition and does not meet current safety standards. Replacement is needed due to concrete deterioration from age and insufficient spillway capacity.
- ◆ Excessive seepage may require the installation of additional drains or relief wells.

### **PROPOSED REHABILITATION**

- ◆ Construct a new spillway that meets or exceeds current safety standards.
- ◆ Investigate the need for additional seepage collection and drains. Install additional drains and seepage collection if needed.

**Estimated Project Cost:** Could exceed \$3,000,000





Downstream face



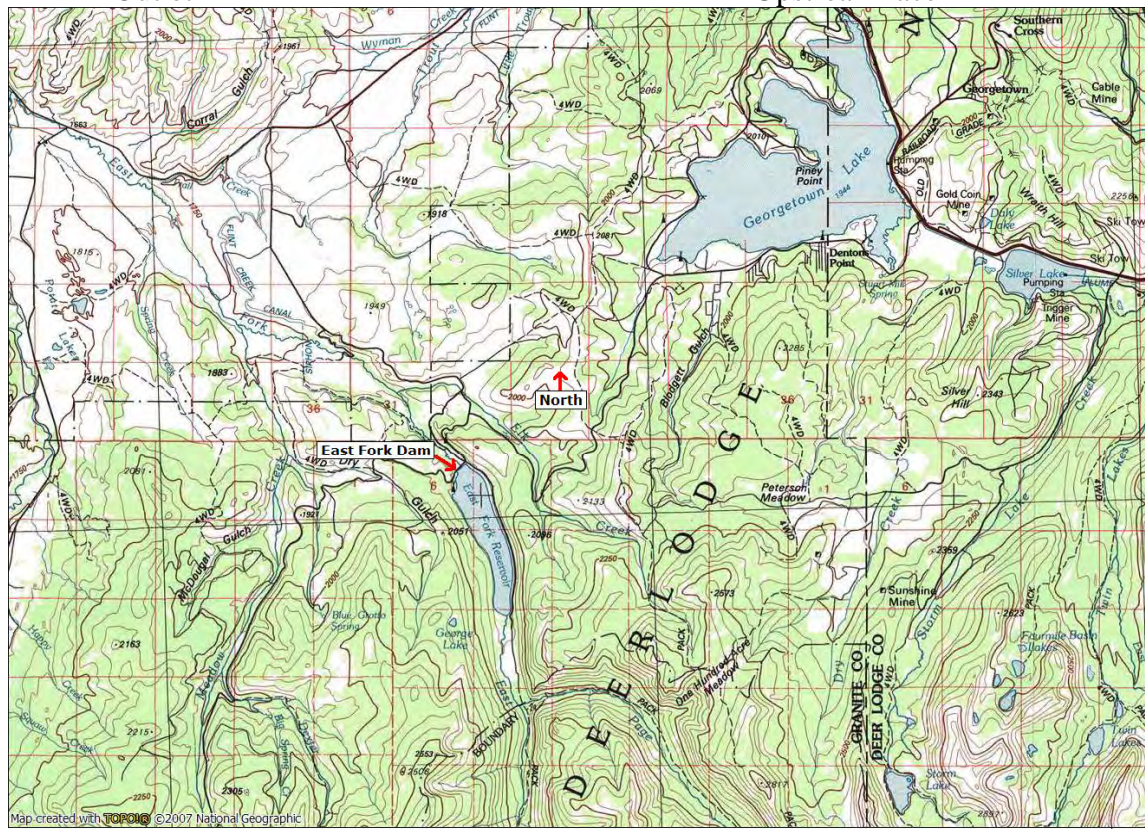
Spillway



Outlet



Upstream face





# **FRED BURR DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on public land in the Bitterroot National Forest in Ravalli County, 9 miles southwest of Victor. Impounds the headwaters of Fred Burr Creek.
- ◆ Owned by DNRC & managed by SWPB under a U.S. Forest Service Special Use Permit.
- ◆ Operated by Fred Burr Water Users Association since 1948
- ◆ Project consists of:
  - ◆ Rolled earthfill embankment dam, 50 feet high, 325 feet long.
  - ◆ 20-foot wide, 120 foot-long, concrete lined rectangular chute spillway with 4.3 foot-high radial gate.
  - ◆ Four-foot diameter reinforced concrete conduit, single cell wet tower with control mechanism at the top of the tower on the dam crest.
  - ◆ Manually operated 48-inch diameter slide gate.
- ◆ Original construction completed in 1948 (dam was breeched during a high runoff episode in the spring of 1948; the dam was reconstructed in 1949).
- ◆ Reservoir stores 525 acre-feet at normal full pool and covers 28 surface acres.

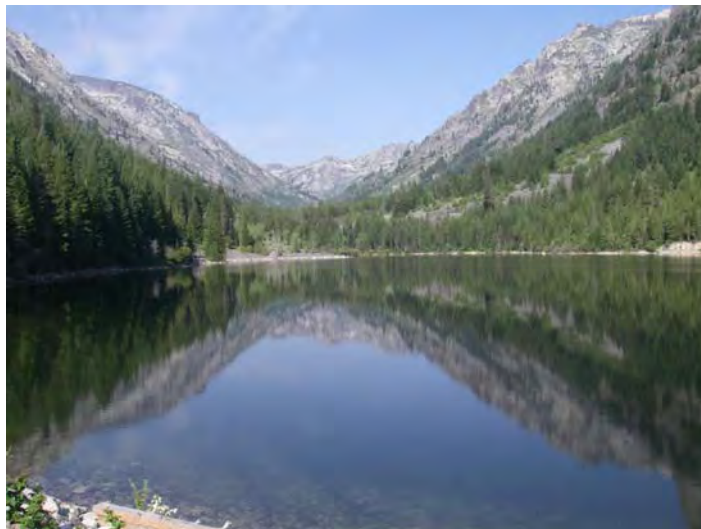
### **PROJECT DEFICIENCIES**

- ◆ The spillway is nearing the end of its design life and will require future replacement. Replacement is needed due to concrete deterioration from age.
- ◆ Current safety standards may require a substantial increase in spillway capacity.
- ◆ The concrete outlet is deteriorating and needs repair. Lining or replacing the outlet are anticipated to be the primary options to correct the deficiencies.

### **PROPOSED REHABILITATION**

- ◆ Construct a new spillway that meets or exceeds current safety standards.
- ◆ Line the existing outlet or replace with a new structure.

**Estimated Project Cost:** Could exceed \$2,000,000



Fred Burr Reservoir looking west





Downstream face



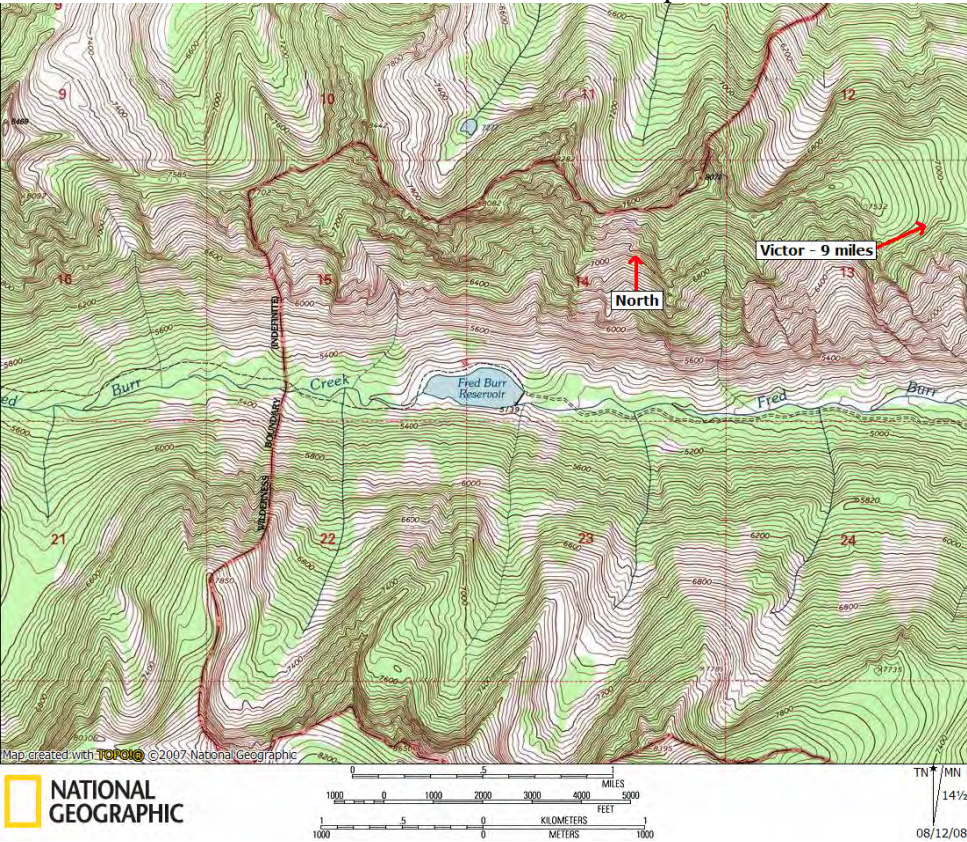
Spillway



Outlet



Upstream face and crest



# **FRENCHMAN DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Impounds Frenchman Creek in Phillips County.
- ◆ Located approximately 20 miles north of Saco.
- ◆ Owned by DNRC & managed by SWPB.
- ◆ Operated by Frenchman Water Users Association since 1952.
  
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 44 feet high, 2,100 feet long.
  - ◆ Reinforced concrete spillway, 119 feet-wide, with uncontrolled ogee crest.
  - ◆ 60-inch, 230 foot-long reinforced concrete outlet with 2, 60-inch slide gates (one emergency and one operating).
  
- ◆ Original construction completed in 1951; the dam failed during a flood in 1952 and was subsequently rebuilt.
- ◆ Reservoir storage design capacity was 7010 acre-feet at spillway crest (see deficiencies), covering an estimated 800 to 1,000 surface acres .
- ◆ 19 water users, irrigates approximately 7000 acres.

### **PROJECT DEFICIENCIES**

- ◆ Voids underneath the spillway and offset joints indicate progressive deterioration.
- ◆ Sedimentation has greatly diminished the storage capacity by about 50% (based on aerial photography the existing capacity is estimated at 3752 acre-feet).

### **PROPOSED REHABILITATION**

A feasibility study was funded by the 2007 Legislature to determine the best alternatives for rehabilitation. The rehabilitation would include the following:

- ◆ Replace the spillway with a new structure.
- ◆ Restore lost storage capacity.

Estimated cost: \$5,000,000





Downstream face



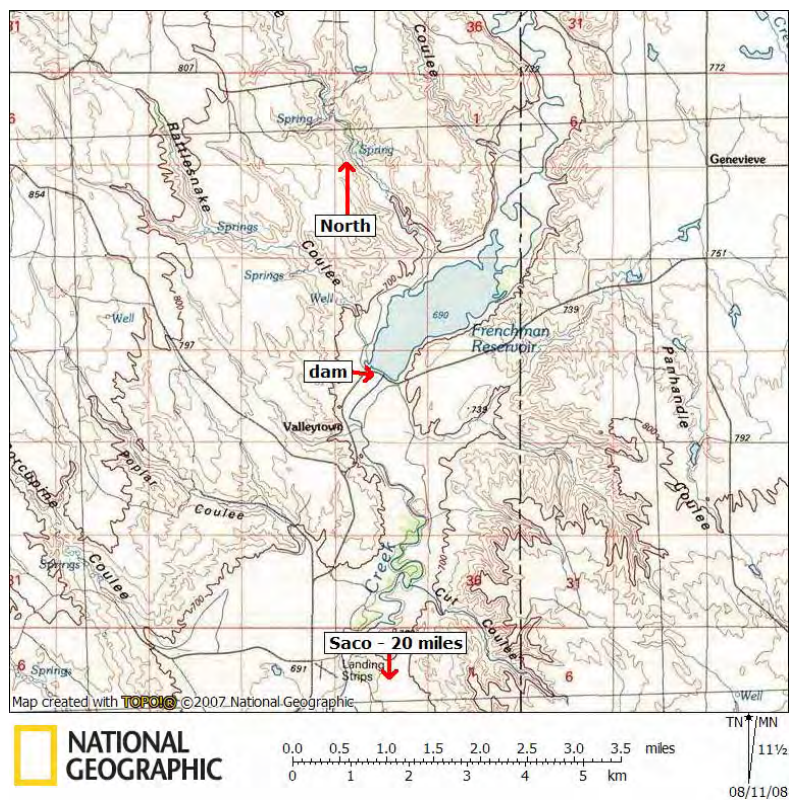
Outlet



Spillway and county road bridge



Upstream face



# GLACIER LAKE DAM

## Fact Sheet

### **PROJECT DESCRIPTION**

- ◆ Located on Rock Creek 35 miles southwest of Red Lodge on the Custer National Forest in Carbon County. Constructed by the State Water Conservation Board in 1937.
- ◆ Owned by DNRC & managed by SWPB under a U.S. Forest Service Special Use Permit.
- ◆ Operated by Rock Creek Water Users Association since 1937
- ◆ The natural storage of Glacier Lake was increased with the construction of two dams;
- ◆ Normal full-pool storage is 4,200 acre-feet with a surface area of 151 acres.
- ◆ Project consists of:
  - ◆ Two rockfill dams with concrete upstream face,

#### North Dam

57 feet high

230 feet long.

#### South Dam

20 feet high

253 feet long

- ◆ Uncontrolled rock channel spillway discharging over a low concrete weir.
- ◆ Low level outlet is a blasted rock tunnel beneath the North Dam, approximately 6.5 feet high by 5.5 feet wide.
- ◆ The outlet is controlled by one 48-inch by 48-inch rectangular slide gate.
- ◆ The operating controls are in a wooden gatehouse, located on the on the North Dam crest.
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain.

### **PROJECT DEFICIENCIES**

- ◆ The spillway does not meet current safety standards.

### **PROPOSED REHABILITATION**

- ◆ Construct a new spillway that meets or exceeds current safety standards.

**Estimated Project Cost:** Could exceed \$2,000,000



Glacier Lake

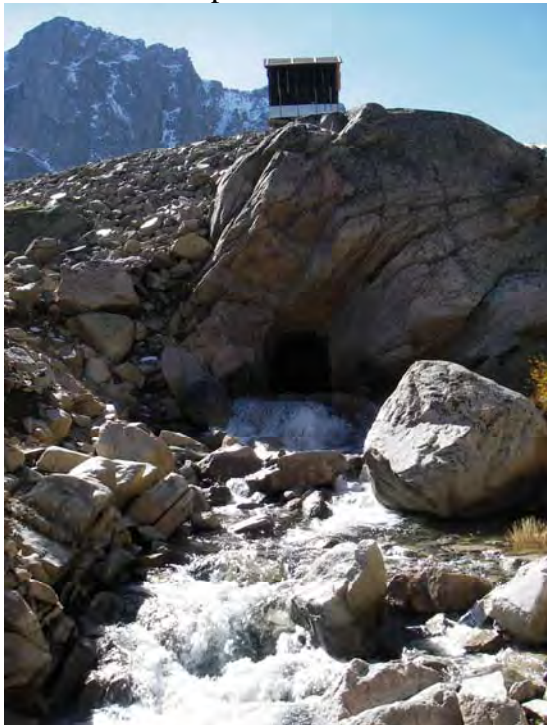




Upstream face



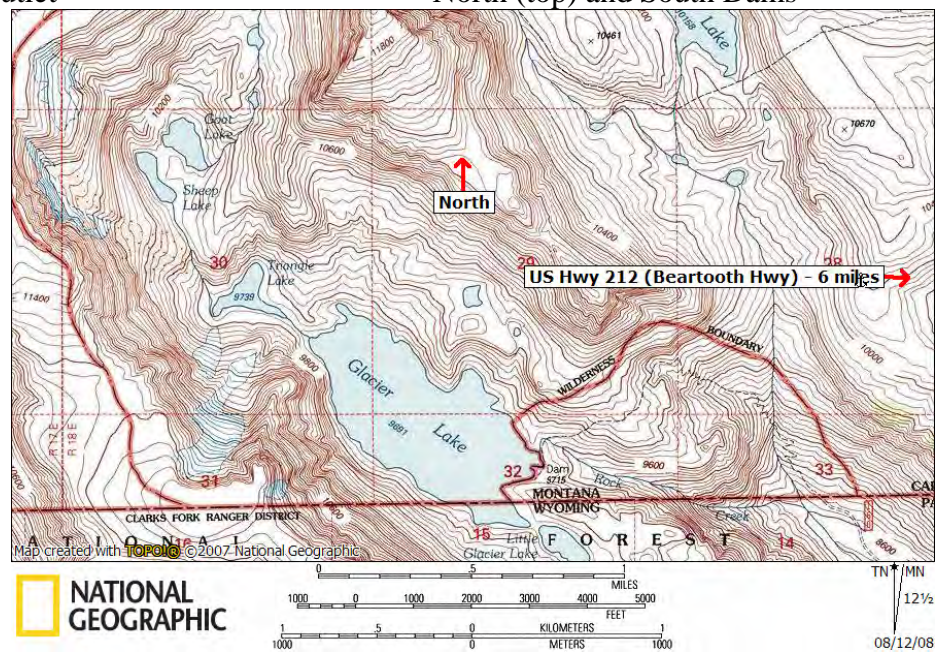
Spillway



Outlet



North (top) and South Dams



# MARTINSDALE DAM

## Fact Sheet

### **PROJECT DESCRIPTION**

- Off stream storage project, in Wheatland and Meagher Counties
- 2.5 miles southeast of Martinsdale
- Owned by DNRC & managed by SWPB
- Operated by Upper Musselshell Water Users Association since 1939
- Project consists of two, Zoned Earthfill Dams:

<u>North Dam</u>	<u>East Dam</u>
91 feet high	49 feet high
1,000 feet long	1,550 feet long
Gated, reinforced concrete 60" outlet conduit, 120 feet-long, 54-inch emergency slide gate and 54-inch operating butterfly valve with controls at the top of the tower.	Concrete chute spillway Earth-rock lined emergency spillway
- Constructed in 1939
- Storage at full pool is 23,348 acre-feet covering 985 surface acres.
- 86 water users have 101 contracts for 21,718 acre/feet of water
- The delivery of irrigation water is vitally important to the water user farm/ranch operations.
- Popular recreation site, primarily for fishing. A DFWP Fishing Access Site is located on the reservoir's north shore.

### **PROJECT DEFICIENCIES**

- Large amounts of seepage occurs in the north dam. Grouting for seepage control had limited success. Additional drains were installed in 1985 to collect seepage and improve embankment stability. The configuration of the existing drains makes it unsafe and difficult to monitor flows. In addition, sedimentation is occurring in the toe drain and cannot be accurately measured. Excessive seepage and sedimentation may indicate a potential problem within the dam, but this cannot be determined with the existing drain configuration. In order to improve seepage collection and make accurate measurements of flows and sedimentation, modification of the drains is necessary.

### **PROPOSED ACTIONS TO ADDRESS DEFICIENCIES**

Modification of the drain system to allow accurate and safe measurements of flows and sedimentation, including the following:

- Add manholes to the toe drain system for flow measurements and trapping sediment.
- Redirect the outfall of the right abutment horizontal drain system further downstream to allow for safe and accurate flow measurements.
- Install a right groin drainage system to address the remaining seepage.
- Install automated instrumentation to allow for continual monitoring. The improved monitoring capabilities are required for compliance with the current operating permit.
- The Department is requesting a \$100,000 Renewable Resource Grant from the 2009 Legislature for partial project payment. The DNRC will pay for remaining cost.





**North Dam,**



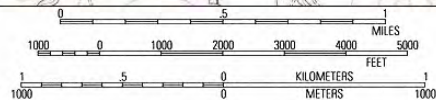
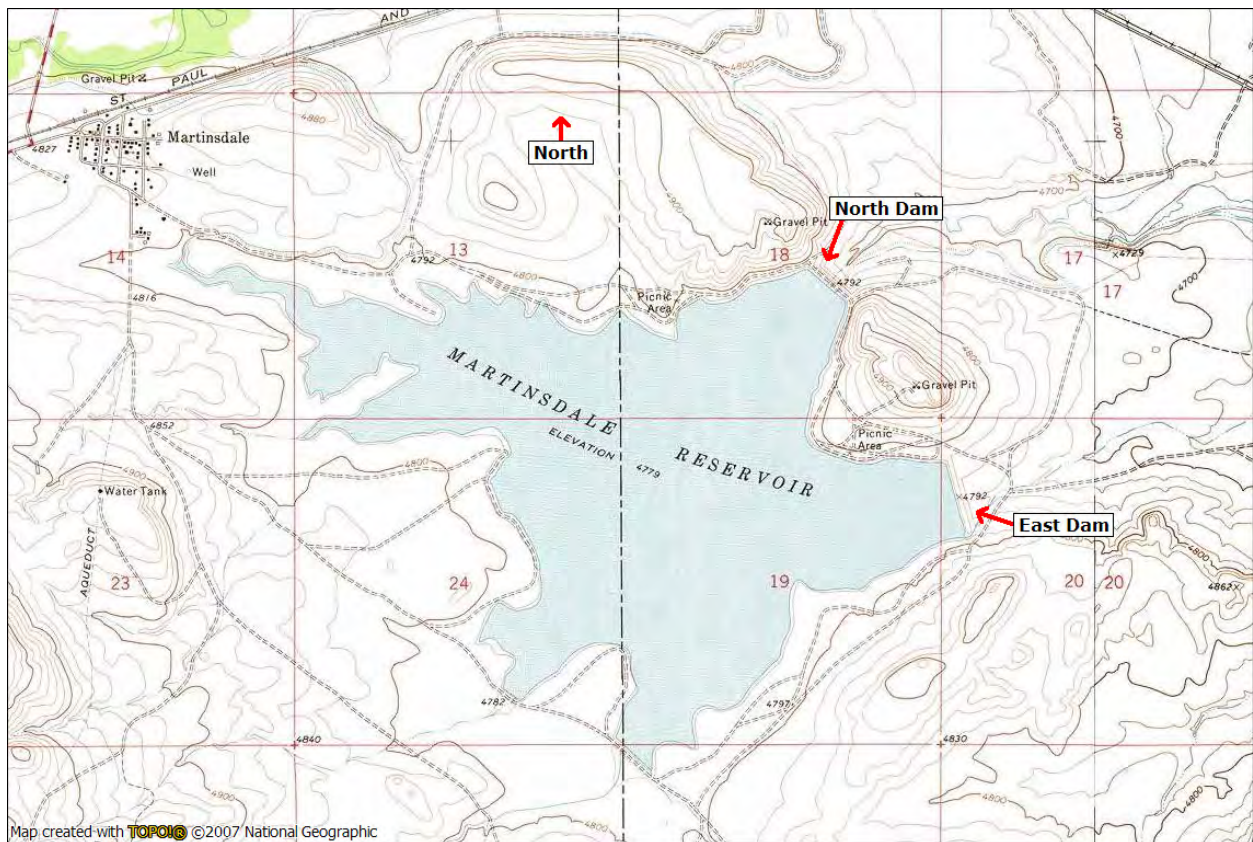
**Outlet on North Dam Downstream Face**



**East Dam**



**East Dam Spillway**



TN ↑ MN  
13°  
08/15/08

# **MIDDLE CREEK DAM (HYALITE)**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on Middle Creek, 15 miles south of Bozeman on the Gallatin Forest in Gallatin Co.
- ◆ Owned by DNRC & managed by SWPB under a U.S. Forest Service Special Use Permit.
- ◆ Operated by Middle Creek Water Users Association since 1951. Project consists of:
  - ◆ Earthen Dam with concrete panels on downstream side, 125 ft. high, 1,900 ft. long.
  - ◆ 5-foot diameter, cast in place steel-lined concrete conduit.
  - ◆ One, 54-inch diameter butterfly operating gate and a 54-inch emergency gate valve
  - ◆ The gate valves are operated from a tower on the dam crest.
  - ◆ The principal spillway has a labyrinth crest inlet and two baffled apron type spillway chutes.
  - ◆ The auxiliary spillway is earth lined with a 530 foot-long concrete crest.
- ◆ Original construction completed in 1951
- ◆ Reservoir stores 10,184 acre-feet at normal full pool, covering 490 surface acres.
- ◆ Provides irrigation water for 73 farms and ranches and drinking water for 2,000 households (1/3 of the City of Bozeman water supply is provided by the project).
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Farms and ranches, homes, schools, roads, bridges and utilities are in the flood plain.

### **PROJECT DEFICIENCIES AND REHABILITATION**

- ◆ No deficiencies currently exist.
- ◆ The dam embankment was raised 10 feet in 1991-1992 as part of a major rehabilitation that included a new spillway, outlet conduit and seepage and drain system. The project meets all current safety standards.

Project Cost (1992 Dollars) \$5,200,000. Funding was secured through a federal loan.

### **PROPOSED IMPROVEMENTS**

- ◆ An updated automated instrumentation system will be installed in the fall of 2008. The new system will improve seepage, drain flow and reservoir monitoring. Included as part of this project was a feasibility study on installing an early warning system.

Project Cost: \$137,525.





Upstream face



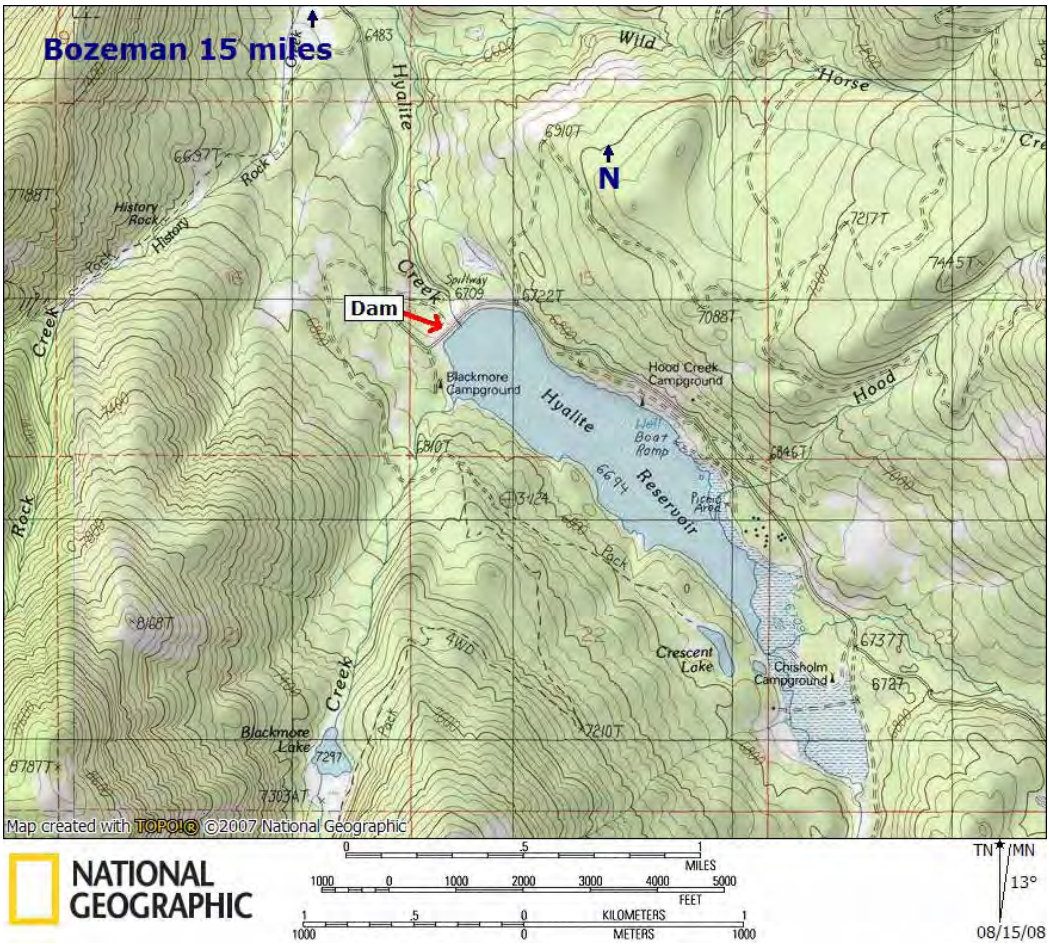
Downstream face



Lower Spillway



Upper Spillway





# NEVADA CREEK DAM

## Fact Sheet



### **PROJECT DESCRIPTION**

- ◆ Located on Nevada Creek in Powell county
- ◆ Adjacent to State Hwy 141, between Avon and Helmville
- ◆ Nevada Creek is a major tributary of the Blackfoot River
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Nevada Creek WUA since 1939
  
- ◆ Project consists of:
  - ◆ Earthfill Dam, 105 feet high, 1,083 feet long.
  - ◆ Uncontrolled ogee crest concrete chute spillway.
  - ◆ 5-foot diameter, 472 foot-long, gated, reinforced concrete outlet conduit.
  - ◆ 54-inch diameter gate valve upstream (emergency gate) and 54-inch butterfly valve (operating gate).
- ◆ Original construction completed in 1938
- ◆ Normal storage at spillway crest is 11,152 acre-feet, covering 368 surface acres.
- ◆ 17 water users have 35 contracts and irrigate approximately 5,600 acres with two canals: Douglas Canal (12.7 miles long) North Canal (13.4 miles long)
- ◆ The dam is a “high hazard” structure which means that its failure could cause loss of life. Numerous houses, roads, bridges, canals and utilities are located in the flood plain below the dam.

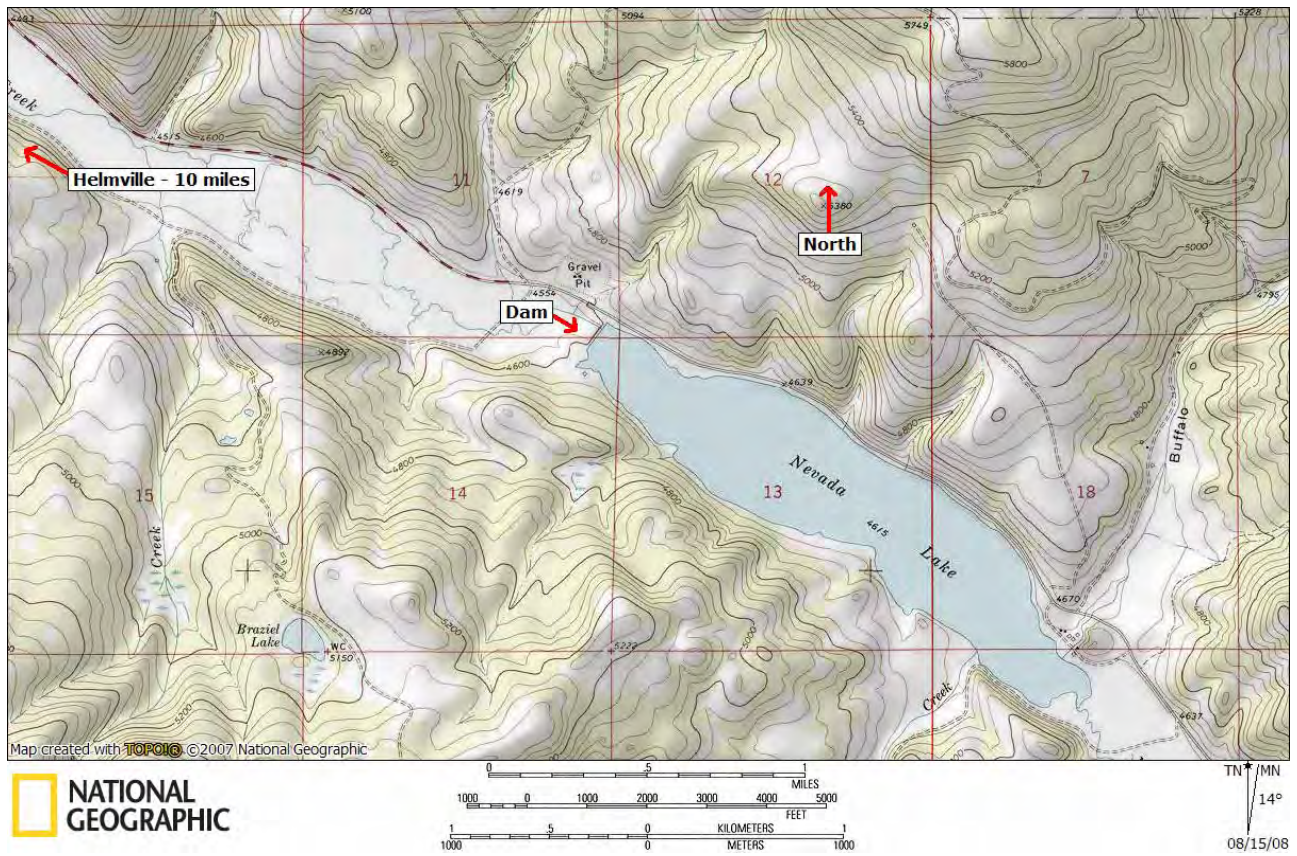
### **REHABILITATION**

A major rehabilitation was completed in 2003. The project included the replacement of the spillway, extension of the outlet works, relief wells to reduce foundation pressures, and the addition of a toe berm to enhance embankment stability.

The rehabilitation brings the dam into full compliance with current dam safety standards.

**PROJECT COST: \$2,000,000**





New Spillway



Upstream Face

# **NORTH FORK SMITH RIVER DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on the North Fork of the Smith River in Meagher County
- ◆ 10 miles East of White Sulphur Springs
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Smith River WUA since 1936
- ◆ Project consists of:
  - ◆ Earthen Embankment Dam, 84 feet high, 1,300 feet long.
  - ◆ Labyrinth weir spillway with excavated rock channel.
  - ◆ Gated, reinforced concrete outlet conduit
  - ◆ 5 foot by 5 foot reinforced concrete, modified horseshoe shaped conduit with manually operated 54-inch diameter emergency slide gate and 54- inch butterfly operating gate.
- ◆ Original construction completed in 1936
- ◆ Normal storage is 11,500 acre-feet, covering 335 surface acres.
- ◆ 29 water users have 40 contracts and irrigate approximately 11,000 acres with one canal (Southside Canal; 13.2 miles long)
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. Numerous roads, bridges, and utilities are located in the flood plain. White Sulphur Springs, (pop. 1,018) would begin flooding approximately 3 hours after failure of the dam.

### **PROJECT DEFICIENCIES**

- ◆ The dam was rehabilitated in 2006. The rehabilitation brings the dam into full compliance with current safety standards.

### **REHABILITATION**

The rehabilitation included the following:

- ◆ A new structural two-cycle labyrinth weir concrete spillway
- ◆ Raising and leveling the dam crest
- ◆ Replacing the outlet works terminal structure with a new structure.
- ◆ Enlarged the rock spillway channel
- ◆ Installed new drains for seepage control

**Project Cost: \$825,000**





New Spillway



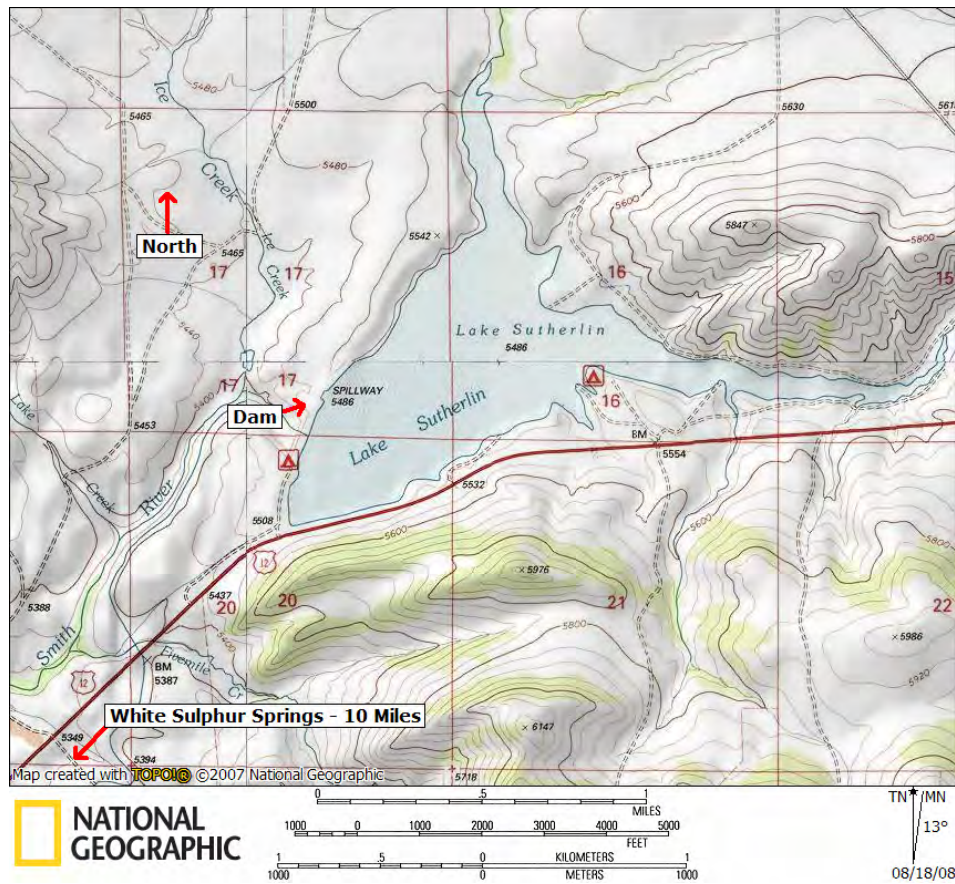
Upstream Face



Downstream Face



New Outlet



# NILAN DAMS

## Fact Sheet

### **PROJECT DESCRIPTION**

- ◆ Off-stream reservoir located 7 miles west of Augusta in Lewis & Clark County
- ◆ Owned by DNRC & managed by SWPB
- ◆ Operated by Nilan WUA since 1952
- ◆ The reservoir is a popular recreation site, primarily for fishing. The DFWP manages a Fishing Access Site under a DNRC lease on the south shore of the reservoir.
- ◆ Project consists of two dams:

#### North Dam:

- ◆ 54 feet high
- ◆ 530 feet long
- ◆ No spillway

#### East Dam

- 51 feet high
- 1,010 feet long
- Concrete control section spillway

Each dam has a gated, reinforced concrete outlet conduit, and a 4-foot diameter cast-in-place reinforced concrete tunnel.

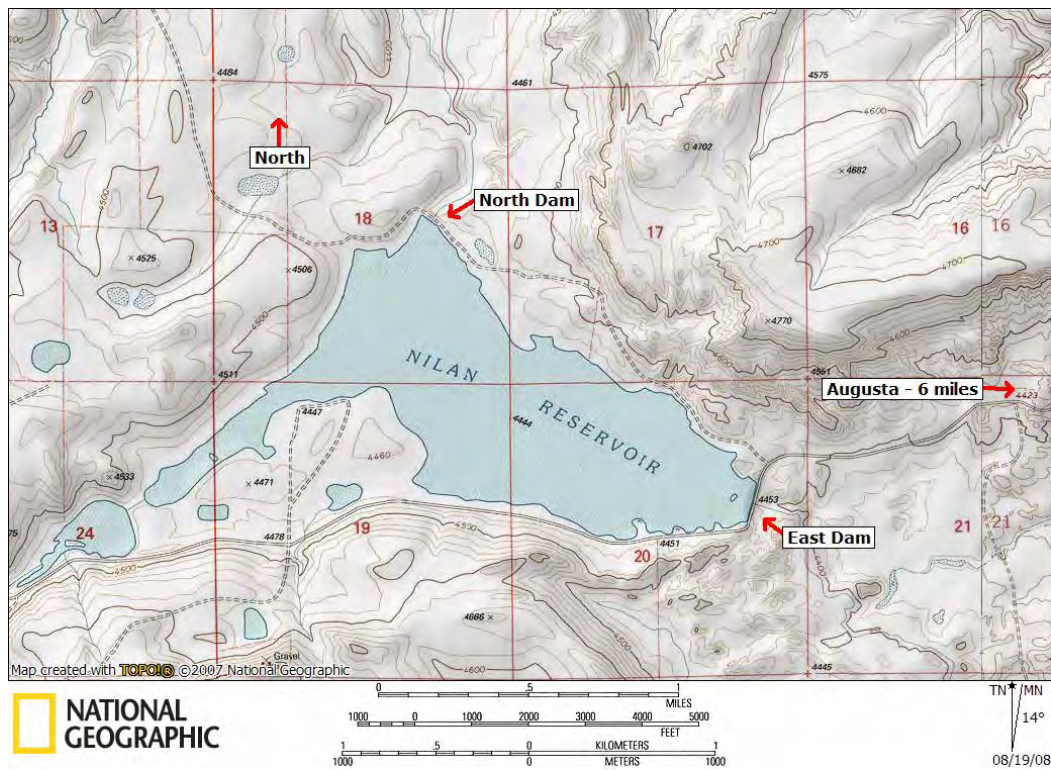
Control towers at each dam are located on the dam crest, consisting of a double chambered wet tower with a 48-inch slide operating gate and 48-inch square emergency slide gate. Controls for the gates are located at the top of the towers.

- ◆ Original construction completed in 1951
- ◆ Normal storage is 10,092 acre-feet, covering 525 surface acres.
- ◆ 27 water users have 53 contracts
  - ◆ And irrigate approximately 10,000 acres with two canals (12.7 mile-long North Canal; 5.8 mile-long East Canal).
- ◆ The dam is a “high hazard” structure, which means that its failure could cause loss of life. The town of Augusta (population 284) is located 7 miles east and downstream of Nilan Reservoir.
- ◆ Numerous houses, roads, bridges, and utilities are located in the flood plain below the dam

### **PROJECT STATUS**

- ◆ Several major repairs were completed on the East Dam in 1999 to repair sinkholes that developed along the upstream toe. A new outlet terminal structure and drain system was installed at the north dam in the spring of 2008.
- ◆ The project meets or exceeds all current dam safety standards.





North Dam



East Dam



New Outlet Terminal Structure at North Dam



East Dam Spillway

# **PAINTED ROCKS DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- Located on the West Fork of the Bitterroot River, 30 miles southwest of Darby in Ravalli Co.
- Owned by DNRC, managed and operated by SWPB
- Project consists of:
  - 143 feet-high, 800 foot-long rolled earthfill dam with impervious center.
  - Reinforced concrete chute spillway.
  - Circular 10-foot diameter concrete lined rock outlet tunnel.
  - 10-foot diameter, horseshoe shaped reinforced concrete tunnel, with two 5 foot by 8 foot gates (one operating and one emergency), located at the bottom of a vertical wet tower.
- Constructed in 1939
- Storage at full pool is 32,362 acre-feet, covering 655 surface acres.
- DFWP purchases 15,000 acre-feet of water for downstream fisheries
- Painted Rocks Water Users Association has 41 contracts for 10,000 acre-feet of water
- Montana Fish, Wildlife and Parks pays half of the operating and maintenance costs, with the water users paying the remaining half.

### **PROJECT DEFICIENCIES**

- The spillway stilling basin floor is severely eroded.
- The spillway chute concrete is deteriorated and needs repairs or replacement.
- The spillway configuration has undesirable flow characteristics that reduce its safe capacity.

### **PROPOSED ACTIONS TO ADDRESS DEFICIENCIES**

Repairs and maintenance are on-going and have included the following:

- The operating gate was removed, repaired and reinstalled during the summer of 2008. Cost of the repair was \$53,738, paid for by the water users.
- A feasibility study that assessed the condition of the spillway and gate repairs was conducted was completed in 2007. Cost: \$130,874, paid by the DNRC.
- The emergency gate roller chain was replaced in 2006 at a cost of \$50,377. The water users paid the majority of the cost.
- The gate hoist mechanism was rehabilitated in 2005. The \$23161 cost was paid for entirely by the water users.
- A new log boom and security fence were installed in 2004. The water users paid for the log boom and the DNRC for the fence. Costs: Log Boom – \$20,453; Fence - \$4,916
- A spillway rehabilitation study is on-going.

Est. cost for rehabilitation includes \$5 million for gates, \$8 million for the spillway, and \$750,000 for the stilling basin.





Spillway



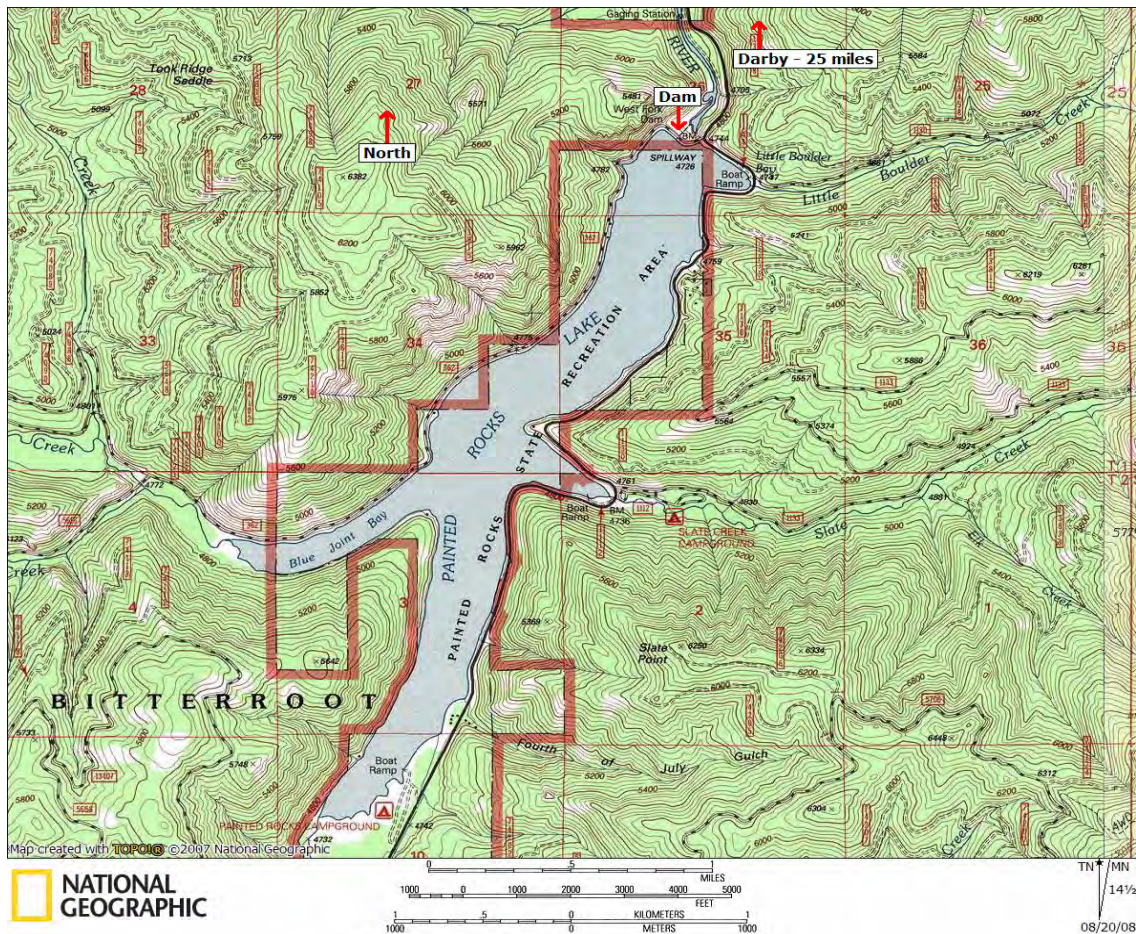
Log Boom



Forest Service Access Road across dam



Painted Rock Reservoir





# RUBY DAM

## Fact Sheet

### PROJECT DESCRIPTION

- Located on the Ruby River, in Madison County, 7 miles south of Alder
- Owned by DNRC and operated by Ruby Water Users Association since 1938
- Project consists of:
  - Earthen Embankment Dam, 111 feet high, 846 feet long
  - Reinforced concrete chute spillway
  - Gated, reinforced concrete 90" outlet conduit
- Constructed in 1938
- Storage at full pool is 37,612 acre-feet, covering 970 surface acres.
- Two canals deliver water to purchasers: West Bench, 12 miles long, 85cfs capacity; Vigilante, 26 miles long, 115 cfs capacity
- 191 water users have 225 contracts for 38,845 acre/feet of water

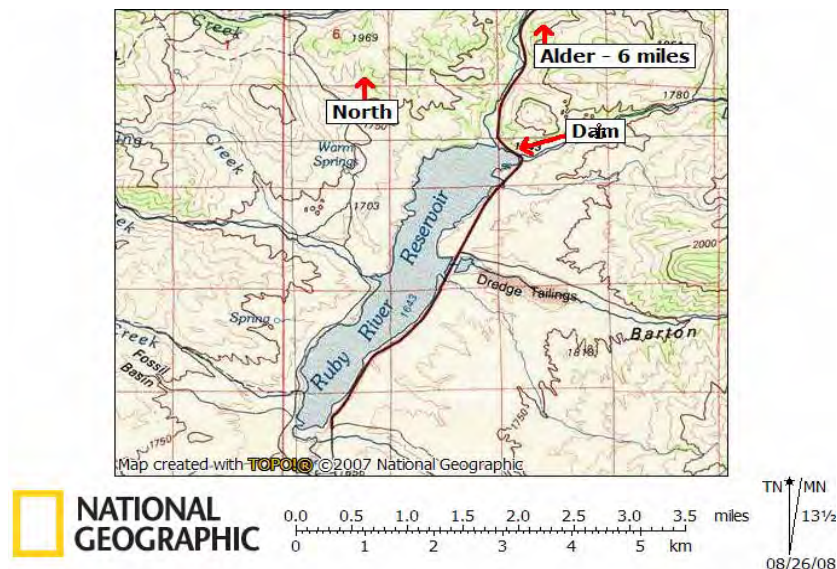
### PROJECT DEFICIENCIES

- Severe concrete deterioration exists in the spillway floor and walls. Spillway replacement is needed to correct the deficiencies.
- Excessive seepage may threaten the structural integrity of the spillway.

### PROPOSED ACTIONS TO ADDRESS DEFICIENCIES

- A feasibility study to evaluate the problems at Ruby Dam at Ruby Dam was completed in 2007 by HLM Engineering of Billings . The \$285,000 feasibility study cost was authorized by the 2006 Legislature and paid by the DNRC.
- This project is in need of major rehabilitation. The preferred alternative identified in the feasibility study for rehabilitation, which includes a new spillway, outlet conduit, drains, access road and additional storage that could be marketed for beneficial uses, will bring the dam into full compliance with current safety and design standards and greatly reduce the state's liability.
- The proposed rehabilitation will also allow for future hydropower development.

**Estimated Cost: \$13,000,000**







**Ruby Dam**



**Ruby Dam Spillway**

# **TONGUE RIVER DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on the Tongue River in Big Horn County, 5 miles north of Decker.
- ◆ Owned by DNRC & managed by the Tongue River Water Users Association since 1938.
- ◆ Project consists of:
  - ◆ Zoned Earthfill Dam, 93 feet high, 1,824 feet long
  - ◆ Uncontrolled, 150 foot-wide, 560 foot-long concrete labyrinth weir principle spillway. Emergency spillway consists of roller compacted concrete with conventional concrete encasement stair step chute with an ogee crest, 650 feet-wide.
  - ◆ 16-foot horseshoe-shaped concrete auxiliary outlet tunnel; downstream and upstream wet wells with a 4.5 foot by 7 foot fixed wheel emergency gate and cast iron operating sluice gate.
- ◆ Original construction completed in 1940 by the State Water Conservation Board.
- ◆ Stores 79,071 acre-feet at normal full pool, covering 3,700 surface acres.
- ◆ A very popular recreation site, with Tongue River State Park, managed under lease by the MT Dept. of Fish, Wildlife and Parks, located on the west shore of the reservoir.
- ◆ Provides a portion of the Northern Cheyenne Tribe's federally reserved water right.
- ◆ The dam is a "high hazard" structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain.

### **PROJECT DEFICIENCIES AND REHABILITATION**

From 1996 to 1999 the DNRC completed a major rehabilitation of the dam. The dam, spillways and outlet works are in good condition and meet or exceed existing dam safety standards. The rehabilitation included:

- ◆ Raising the dam crest an additional 4-feet, providing up to an additional 20,000 acre-feet of storage.
- ◆ Construction of a new primary outlet tunnel and emergency spillway.
- ◆ Replacing the principle spillway.
- ◆ Improvements to the drain system.
- ◆ Improvement to access and maintenance roads.

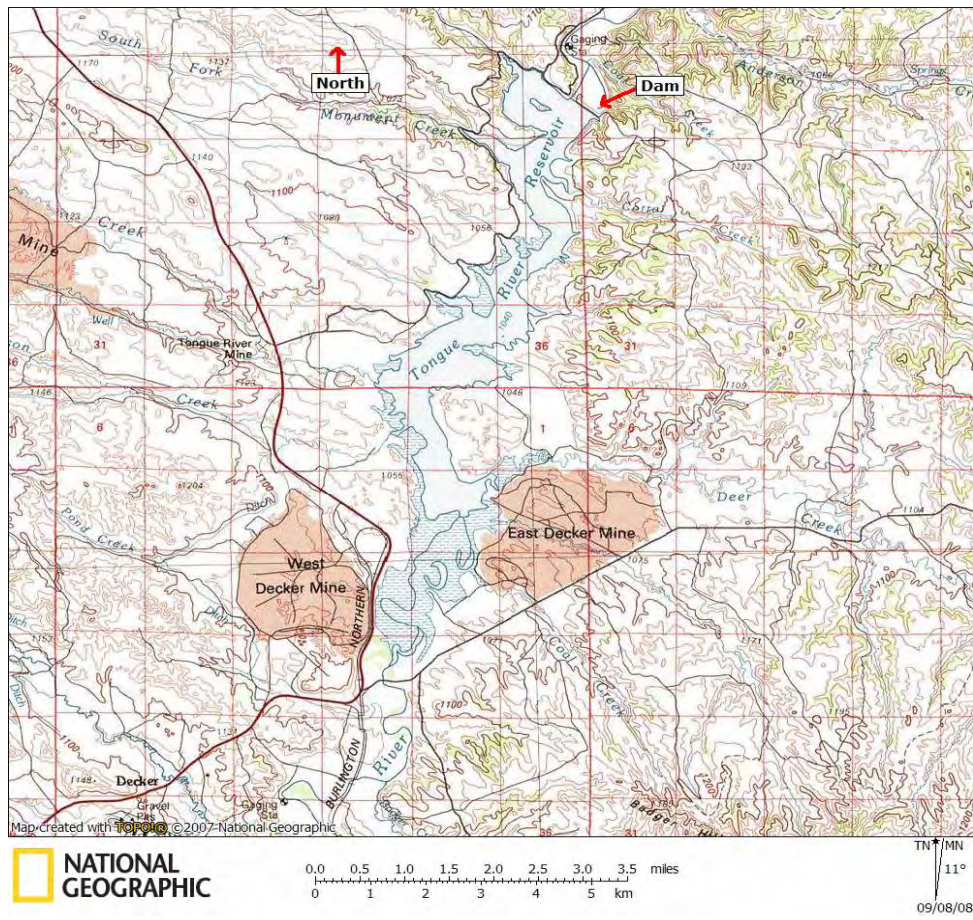
Rehabilitation cost (1999): \$52,000,000

The rehabilitation costs were shared between the DNRC, U.S. Bureau of Reclamation and Northern Cheyenne Tribe.

Repairs are continuing on cracks that appeared in the emergency spillway concrete steps.

Estimated cost of the crack repairs is \$600,000.





Tongue River Dam

# **TONGUE RIVER DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- ◆ Located on the Tongue River in Big Horn County, 5 miles north of Decker.
- ◆ Owned by DNRC & managed by the Tongue River Water Users Association since 1938.
- ◆ Project consists of:
  - ◆ Zoned Earthfill Dam, 93 feet high, 1,824 feet long
  - ◆ Uncontrolled, 150 foot-wide, 560 foot-long concrete labyrinth weir principle spillway. Emergency spillway consists of roller compacted concrete with conventional concrete encasement stair step chute with an ogee crest, 650 feet-wide.
  - ◆ 16-foot horseshoe-shaped concrete auxiliary outlet tunnel; downstream and upstream wet wells with a 4.5 foot by 7 foot fixed wheel emergency gate and cast iron operating sluice gate.
- ◆ Original construction completed in 1940 by the State Water Conservation Board.
- ◆ Stores 79,071 acre-feet at normal full pool, covering 3,700 surface acres.
- ◆ A very popular recreation site, with Tongue River State Park, managed under lease by the MT Dept. of Fish, Wildlife and Parks, located on the west shore of the reservoir.
- ◆ Provides a portion of the Northern Cheyenne Tribe's federally reserved water right.
- ◆ The dam is a "high hazard" structure, which means that its failure could cause loss of life. Farms and ranches, roads, bridges, and utilities are located in the flood plain.

### **PROJECT DEFICIENCIES AND REHABILITATION**

From 1996 to 1999 the DNRC completed a major rehabilitation of the dam. The dam, spillways and outlet works are in good condition and meet or exceed existing dam safety standards. The rehabilitation included:

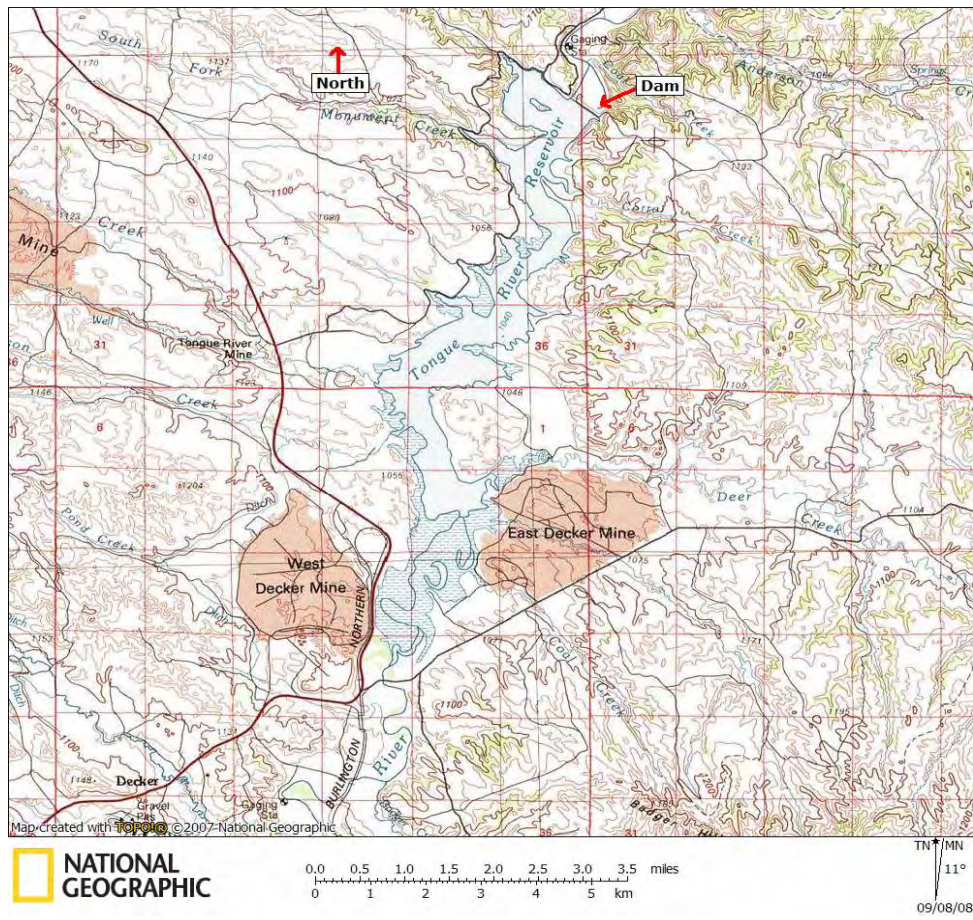
- ◆ Raising the dam crest an additional 4-feet, providing up to an additional 20,000 acre-feet of storage.
- ◆ Construction of a new primary outlet tunnel and emergency spillway.
- ◆ Replacing the principle spillway.
- ◆ Improvements to the drain system.
- ◆ Improvement to access and maintenance roads.

Rehabilitation cost (1999): \$52,000,000

The rehabilitation costs were shared between the DNRC, U.S. Bureau of Reclamation and Northern Cheyenne Tribe.

Repairs are continuing on cracks that appeared in the emergency spillway concrete steps. Estimated cost of the crack repairs is \$500,000.





Tongue River Dam



# WILLOW CREEK DAM

## Fact Sheet

### PROJECT DESCRIPTION

- Impounds Willow and Norwegian Creeks, located in Madison County, 3.5 miles east of Harrison, constructed in 1938.
- Owned by DNRC; operated by the Willow Creek Water Users Association since 1938.
- Project consists of:
  - 105 feet-high, 453 foot long, zoned earth and rock fill dam.
  - Uncontrolled ogee crest concrete chute spillway.
  - 60-inch horseshoe shaped 362 foot long concrete outlet conduit.
  - One 54-inch main operating butterfly valve and one 54-inch emergency gate valve.
- Storage at full pool is 18,000 acre-feet, covering 885 surface acres.
- The Willow Creek Water Users Association has 151 contracts for 11,900 acre-feet of water
- The reservoir is a popular recreation site. The Dept. of Fish, Wildlife and Parks, under a DNRC lease, manages a Fishing Access Site on the west shore of the reservoir .

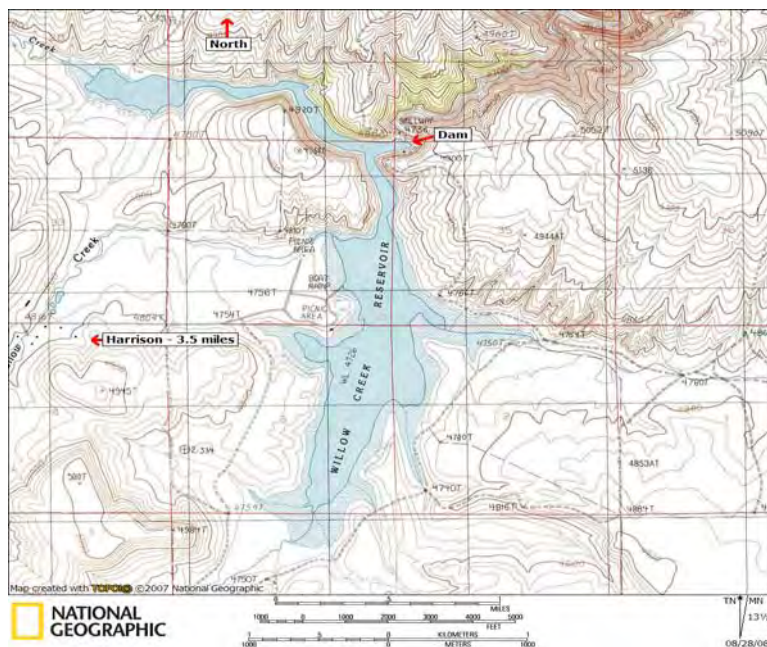
### PROJECT DEFICIENCIES

- The spillway does not meet current safety standards and is not capable of passing the design flood event. The outlet conduit also needs to be assessed for deficiencies. Age related concrete deterioration exists in the spillway wall, floors, and outlet conduit.

### PROPOSED ACTIONS TO ADDRESS DEFICIENCIES

- Replace the spillway with a new structure that meets current safety design standards.
- Install a new outlet conduit.

Estimated Cost: May Exceed \$4,000,000





**Upstream face**



**Downstream face**



**Spillway**



**Outlet**

# **YELLOW WATER DAM**

## **Fact Sheet**

### **PROJECT DESCRIPTION**

- Impounds Yellow Water Creek, located in Petroleum County, 12 miles southwest of Winnett, constructed in 1938.
- Owned by DNRC; operated by the Yellow Water Water Users Association since 1938.
- Project consists of:
  - 37 foot-high, 1,695 foot-long, earthfill dam.
  - Uncontrolled trapezoidal earth and rock lined spillway.
  - 42-inch reinforced concrete pipe outlet, 150 foot-long.
  - One 42-inch slide gate valve with manual operator.
- Storage at full pool is 3,842 acre-feet, covering 490 surface acres.
- The Yellow Water Water Users Association has 4 contracts for 2,000 acre-feet of water.
- The west and south shores of the reservoir are part of the War Horse National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. The reservoir serves as an important nesting area for waterfowl.
- The dam is a “high hazard” structure, which means that its failure could cause loss of life.

### **PROJECT DEFICIENCIES AND CORRECTIVE ACTIONS**

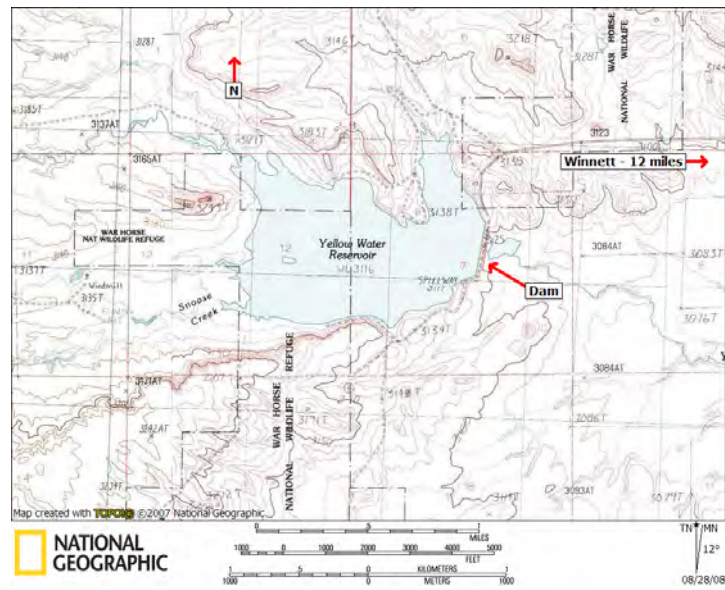
- In 1979, the original spillway was eroding and starting to threaten the embankment. A new spillway was configured running parallel to the embankment utilizing the original spillway entrance.
- In 1980 the Army Corps of Engineers performed an inspection and condemned the outlet due to excessive corrosion of the original CMP.
- Yellow Water Dam underwent a two phase rehabilitation project in 1985. Phase I included the embankment excavation and removal of the original outlet conduit. Phase II included the construction of a new outlet conduit (42-inch diameter reinforced concrete pipe), the inlet and outlet structures, cleaning the original gate and placing riprap on a portion of the upstream face.
- In 2004 the SWP installed 5 monitoring wells with deep and shallow piezometers to enhance the monitoring program. The reservoir has not filled since that time.

### **FUTURE NEEDS**

- The intake structure has a history of plugging up with sediment when the gate is closed during the off season. The intake structure may have to be modified or redesigned and replaced to prevent plugging.
- Seepage has been observed in the vicinity of the left abutment. The drain system may have to be improved to better control and monitor seepage flows.

Estimated Cost of the above repairs: \$500,000





**Upstream face**



**Dam Crest**



**Downstream face**